62-3-4

DETACHMENT 13, 24TH WEATHER SQUADRON
8TH WEATHER GROUP
AIR WEATHER SERVICE (MATS)

TERMINAL FORECASTING REFERENCE FILE

Tinker Air Force Base

Oklahoma City, Oklahoma

JANUARY 1962

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F O R E W O R D

The original study (Report No. 600-169, 1944) has been revised to include additional information now available and to reflect recent changes in operations at this terminal. Many of the original features have been retained, particularly in Sections I and II, but they have been separated according to content to make this Reference File a more usable tool.

Section IV (Local Forecast Studies) is a section that can be expected to grow and accumulate with each periodic revision. It should reflect operational changes requiring forecasts of differing weather elements or categories as well as acquire progressive revision in light of accumulative experience and improvements on current forecasting techniques.

CONTENTS

SECTION I

LOCATION AND TOPOGRAPHY

TINKER AIR FORCE BASE, OKLAHOMA

1. Location and Topography

Tinker Air Force Base is located approximately seven miles east southeast of Oklahoma City, Oklahoma, at 35° 25' north latitude and 97° 24' west longitude. The field elevation is 1291 feet above mean sea level.

The Tinker-Oklahoma City locality lies on the border of the two major topographic regions to be found in the State of Oklahoma. To the west is a slightly rolling prairie, sloping gently from west to east with an average fall of eight feet to a mile. The highest point in this section is the Black Mesa at about 4,500 feet MSL. The elevation decreases to less than 900 feet MSL in the Red River Valley near the southern boundary of the state. The west-central section of Oklahoma is a nearly level plain with little hill country and practically no timber. In the southwest, the Wichita Mountains, consisting of a number of scattered peaks, extend for about 60 miles east and west. These peaks rise to a maximum of 2479 feet MSL with an average elevation of 1,000 to 1,200 feet above the surrounding plain. The only extensive wooded tracts in Western Oklahoma are found in these mountains.

East of Tinker the land still slopes to the south and east. The northern portion is a rolling and somewhat broken prairie country with a general elevation of 800 to 1,000 feet MSL. There are no mountains or hills of any significant elevation. However, in the extreme northeast the extension of the Ozark Mountains form a broad plateau with a general elevation of about 1,100 feet with scattered ridges rising 200 to 300 feet above the general level. In the southeast, the long, narrow, parallel ridges of the Ouachita Mountains rise to heights of 2,500 to 2,900 feet MSL.

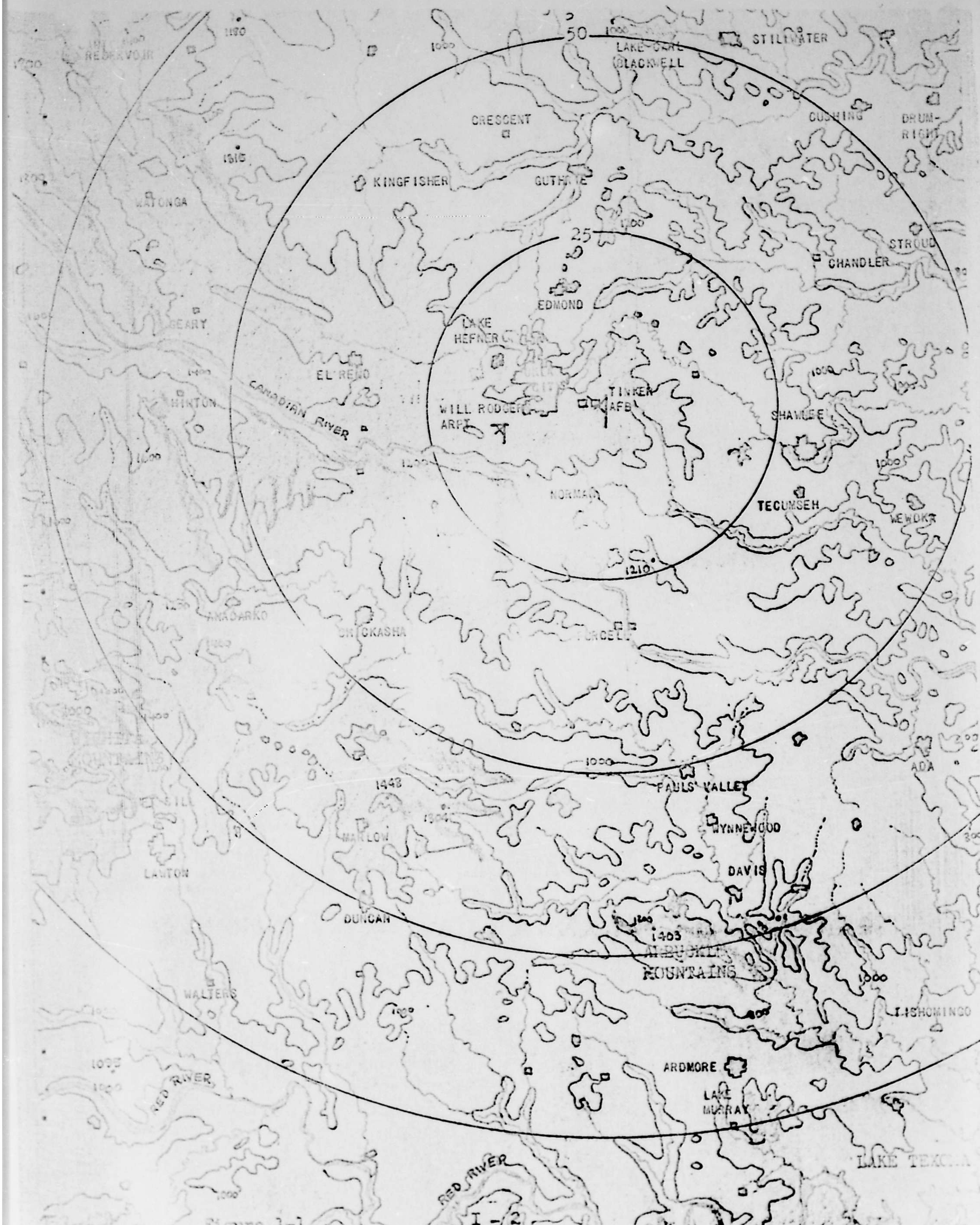

50
25
STILLWATER
LAKE CARL BLACKWELL
CRESCENT
CUSHING
DRUM-RIGHT
KINGFISHER
GUTHRIE
WATONGA
STROUD
CHANDLER
EDMOND
GEARY
LAKE HEFNER
EL RENO
HINTON
CANADIAN RIVER
TINKER AFB
WILL RODGERS ARPT
SHAWNEE
NORMAN
TECUMSEH
WEWOKA
ANADARKO
CHICKASHA
PURCELL
ADA
PAULS VALLEY
WYNNEWOOD
MARLOW
LAWTON
DAVIS
DUNCAN
ARBUCKLE MOUNTAINS
WALTERS
TISHOMINGO
ARDMORE
RED RIVER
LAKE MURRAY
LAKE TEXOMA

Figure 1-1

In the large scale topograph surrounding the base there is no significant change in the terrain to the north for some 2,000 miles, or to northern Canada. To the south, the same topography and elevation persists for approximately 400 miles, or to the region of San Antonio, Texas. About 150 miles southeast in the Red River Valley the terrain drops below 500 feet MSL to the Gulf Coastal Plain (1). To the west, the terrain elevation increases to slightly above 5,000 feet MSL in 400 miles to the base of the Rocky Mountains (fig 1-2). This elevation slope is gradual except for a rise of some 1,000 feet in 50 miles in the Texas Panhandle, where some east facing bluffs of some 500 feet or more separate the "Caprock" from the plains.

In summary, Tinker might be thought of as situated on a huge plain, 2,000 miles from its northern boundary, 400 miles from its western boundary, 150 miles from its eastern, and 400 miles from its southern boundary. This plain is tilted upward to the west with its western boundary being about 5,000 feet and its eastern boundary some 500 feet above sea level. There is no tilt to the north-south axis of this plane.

The natural vegetation of the area surrounding Tinker is grass lands except to the southeast, where scrub stands of southern hardwoods begin almost immediately, increasing with distance and lower elevations through the east and south-east quadrants.

The combined factors of uninterrupted terrain and grass lands to the north and west offer no resistance to outbreaks of polar air from Western Canada and from the Great Basin. The Great Plains are unique in the respect of offering perfect drainage with no resistance to polar air masses.

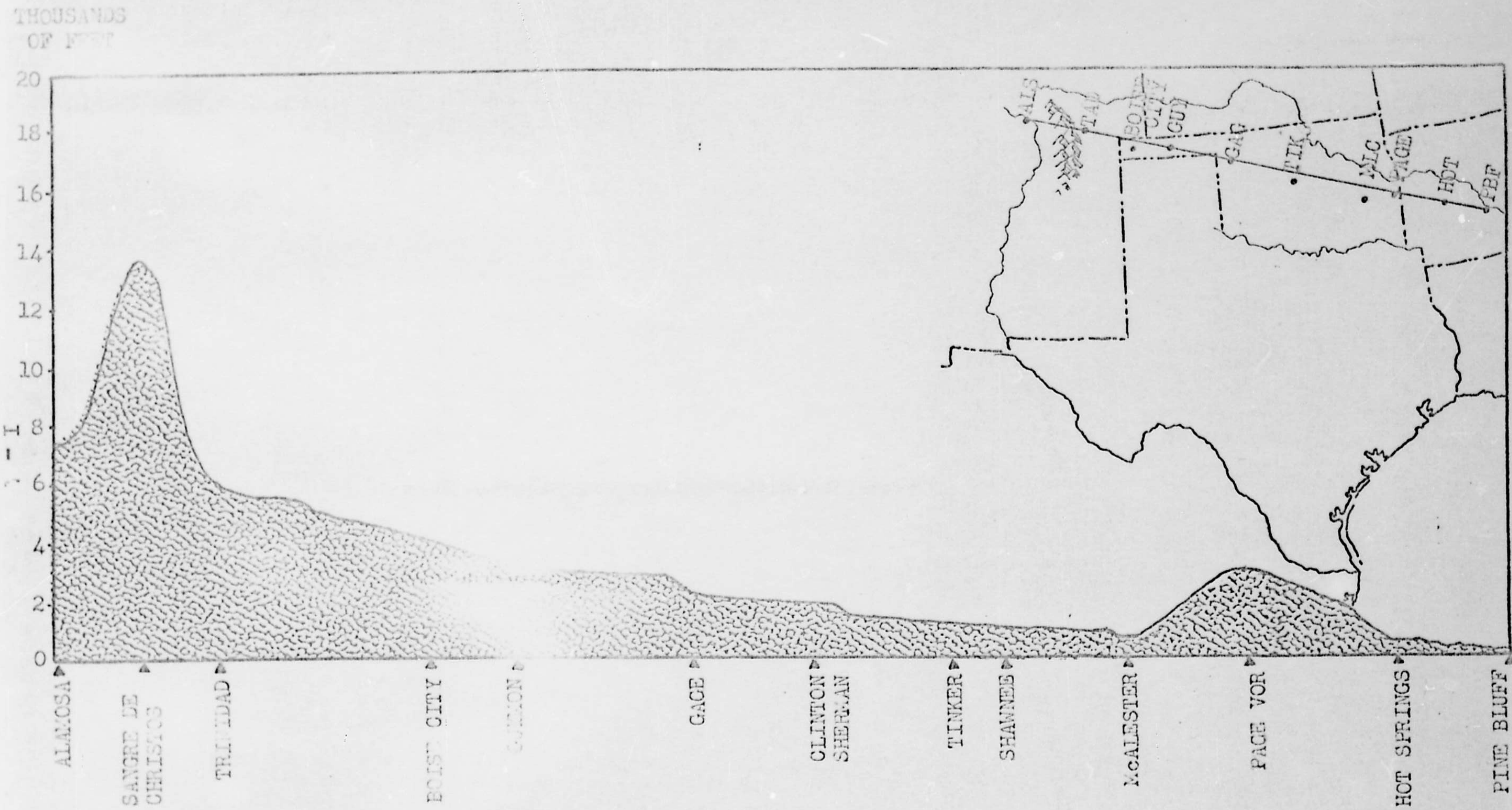


Figure 1-2. Terrain chart illustrating the degree of upslope or downslope mechanism present with an easterly or westerly trajectory of the low level winds.

The first drainage resistance is encountered by polar air masses in the Interior Highlands region, which begins some 100 miles east of Tinker.

An important element in forecasting at Tinker AF Base is the fact that the Great Plains, or grass lands are to the north, west, and south has become the predominant wheat growing area of the United States. This land is tilled and has little vegetation for a large part of the year, and in previous drouth years became known as the "Dust Bowl". Below normal precipitation in this area during the fall, winter, and early spring seasons makes this terminal vulnerable to dust storms with visibilities reduced in locally raised blowing dust or settling dust raised on some occasions hundreds of miles from Tinker during the windy months of February, March, and April.

The nearest point of the Gulf of Mexico is 380 miles to the south south-east of Tinker. Only southeast winds can bring moist gulf air directly to Tinker: since the terrain upslope is gradual, and southeast is a prevailing wind direction, orographic effect is frequently a factor in forecasting.

No other bodies of water are large enough to noticeably affect the climate at Tinker, although the North Fork of the Canadian River flows generally east about 5 miles north of the station; the South Fork of the Canadian flows southeast from about 18 miles south of the station; and the Red River flows east south-east about 100 miles south of Tinker.

No air polution problems from smoke sources outside the Tinker complex are encountered as all heating is done with natural gas in this area and oil refinery and factory smoke are negligible. A very localized problem is occasionally encountered on base due to extensive testing of jet engines.

2. Weather Station Instrumentation

Figure No 1-1 shows the large scale surroundings of Tinker AF Base. Figure 1-3 shows the detailed location of weather station facilities and illustrates the exposure of the instruments. Notations on Figure 1-3 point out each item as follows:

(1) The Forecasting Section is located on the ground floor in the mid-section of hangar #240. The forecasters do not have a window to the outside. The view from the south side entrance to the hangar is open to the south and generally to the east and southwest. The view from the north entrance is entirely blocked to the west by hangar #230, and to the north and east, other buildings seriously limit the range of vision. On 13 February 1957, the "optimum observation site program" was initiated (see 3 below). The CPS-9 console is located adjacent to the briefing section. A polaroid camera is installed on the radar. At this time the receiver of the CPS-9 is modified with a step gain receiver and an "iso-echo" gate.

(2) The antenna tower and modulator room for the AN/CPS-9 radar storm detector.

(3) All surface observations are taken from this site. The ML-19 rain guage, formerly located on a grass area at the southwest corner of hangar 240, was moved 3 Feb 58 to the roof of hangar 3102-30 feet south of the observer's tower. A telautograph transmitter located here permits the observer to disseminate his observations directly to the base weather station, flight operations division, control tower, RAPCON, flight test, 1707th Air Transport Wing (Heavy) Training, engine test, and the 32d Air Division Controller. A magneto telephone also connects

METEOROLOGICAL EQUIPMENT
LOCATED IN BASE WEATHER - BLDG 240

1. AN/CPS-9 Console
2. Wind Panel
3. ML-3 Barograph

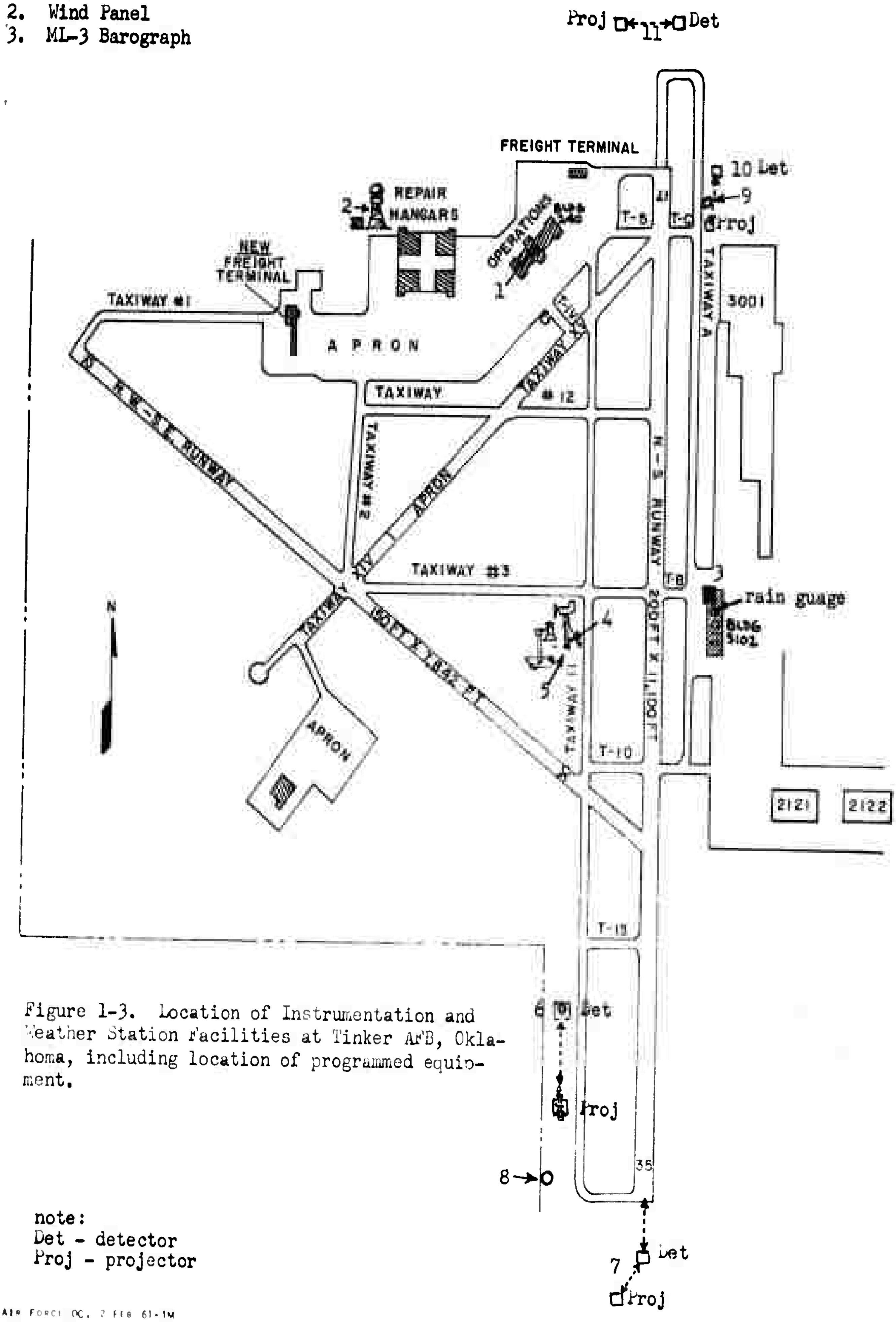


Figure 1-3. Location of Instrumentation and Weather Station Facilities at Tinker AFB, Oklahoma, including location of programmed equipment.

note:
Det - detector
Proj - projector

AIR FORCE OC, 2 FEB 61-1M

the observer directly to the observer serving the forecaster at his location in the representative observation site. This site is considered to be entirely representative. There are no restrictions to vision in any runway approach zone and only very limited close-in restrictions due to warehouses, hangars, etc.

(4) The AN/GMQ-11 wind transmitters are exposed 13 feet above the open unobstructed grass area across the runway and taxi strip west of the observer tower. This instrument replaced the selsyn equipment in April 1958. Programmed locations of the dual anemometers are indicated in positions 8 and 9.

(5) The AN/TMQ-11 (v) Remote Temperature Humidity Set is located approximately 70 feet south of the AN/GMQ-11 anemometer. This set was installed in March 1960.

(6) An AN/GMQ-10-B Transmissometer is located 1100 feet west of the center line of the southern end of runway 17. It was installed in May 1960.

(7) The detector of the AN/GMQ-13 Rotating Beam Ceilometer is located 3350 feet directly south of runway 17. The projector is south of the detector and has a base line of 400 feet. This equipment replaced the AN/GMQ-2 ceilometer in May 1960.

(8) and (9) proposed GMQ-11 installations FY 62.

(10) programmed GMQ-10B location FY 62.

(11) programmed GMQ-13 location FY 62.

S E C T I O N II

WEATHER CONTROLS

TINKER AIR FORCE BASE, OKLAHOMA

LOCATIONS OF STATIONS REFERRED TO BY IDENTIFIERS IN THIS STUDY:

ABQ	Albuquerque, New Mexico
ADM	Ardmore, Oklahoma
LTS	Altus AFB, Oklahoma
DAL	Dallas, Texas
END	Vance AFB, Enid , Oklahoma
TIK	Tinker AFB, Oklahoma
LRY	Lowry AFB, Denver, Colorado
PNX	Perrin AFB, Dennison, Texas
FYV	Fayetteville, Arkansas
SKF	Kelly AFB, San Antonio, Texas
MKC	Kansas City, Missouri
LIT	Little Rock, Arkansas
CSM	Clinton-Sherman AFB, Oklahoma
TUL	Tulsa, Oklahoma
DDC	Dodge City, Kansas
OMA	Omaha, Nebraska
OKC	Oklahoma City, Oklahoma
PNC	Ponca City, Oklahoma
FSM	Fort Smith, Arkansas
TUL	Tulsa, Oklahoma
WNK	Waynoka, Oklahoma
GAG	Gage, Oklahoma
WAO	Waco, Texas
ICT	Wichita, Kansas
SPS	Wichita Falls, Texas
SGF	Springfield, Missouri
MLC	McAlester, Oklahoma

Note: The term closed as used in this and following chapters is synonymous in meaning with "Below GCA Minimums."

1. Major Synoptic Features

A review of the AWS Historical Weather Map Series reveals frontal passages at Tinker with an average frequency as follows:

MONTH	CONTINENTAL POLAR COLD FRONT	MARITIME POLAR COLD FRONT*	MARITIME TROPICAL WARM FRONT
January	4.5	6.0	1.0
February	5.0	5.0	1.0
March	4.0	7.0	1.5
April	4.0	6.0	1.5
May	4.0	4.5	1.5
June	2.0	3.0	1.0
July	1.5	3.0	1.0
August	3.0	2.0	1.0
September	3.5	4.0	1.5
October	4.0	4.0	1.0
November	5.5	5.0	1.0
December	5.0	6.0	1.0
Annually	46.0	55.5	14.0

Cyclone frequencies may be noted from Figures 2-1a and 2-1b (2).

The most persistent air mass over this area is of tropical origin. During the summer and early fall, when the Bermuda ridge has the most pronounced development over the Southeastern United States, and the southwest thermal low is present, a large proportion of the winds at Tinker are from the southern quadrants; in June, for example, these amount to 82%, and even in mid-winter, 51% of the winds have southerly components. When the south winds have a westerly component the air usually tends to be dry and fair weather prevails. On the other hand, when the wind has an easterly component, moisture is readily brought over Tinker from the Gulf of Mexico, and the dew-point spread decreases. In the spring and early summer the moisture from the Gulf maintains the squall line zones through Texas and Oklahoma. Approaching fronts and troughs then initiate pre-frontal squall line thunderstorms in these zones. In the winter time, the influx of Gulf moisture is responsible for the low clouds and fogs that persist in this area.

During the period from August to March, the mean Gulf surface water temperature is much warmer than the free air temperature over it. This means that air masses in their trajectory over the Gulf gain a higher relative humidity in these month. When they are borne inland on southerly winds over the cold land surfaces they become stabilized, producing the overcast skies and fog, which in turn, account for the large amount of "closed" and IFR conditions reflected in graph number 4, Section III.

*The Maritime polar air masses are modified over the Rocky Mountains.

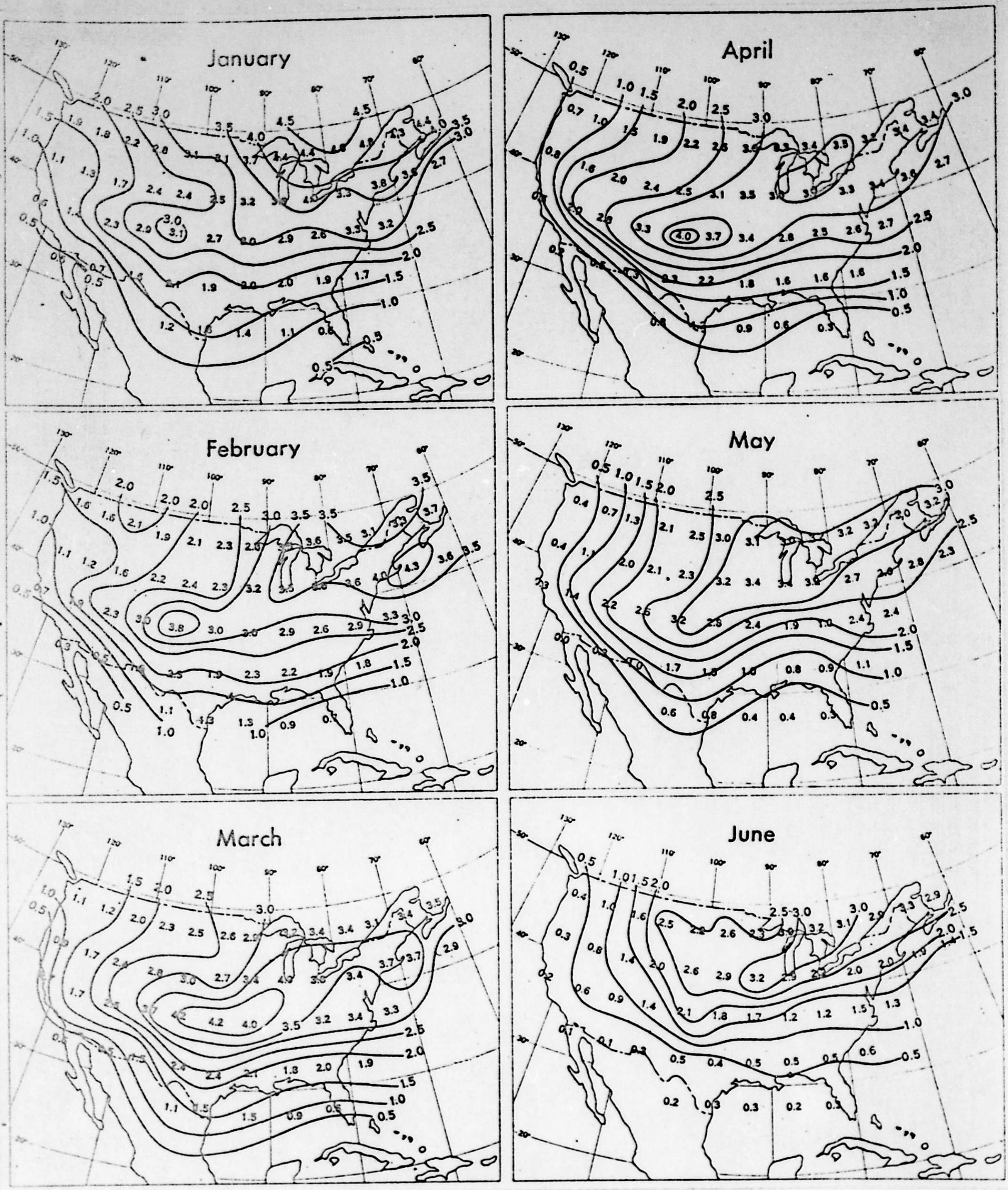


Figure 2-1a. Number of cyclones passing through each 5° latitude-longitude grid in the United States, by months, 1905-1954 (2).

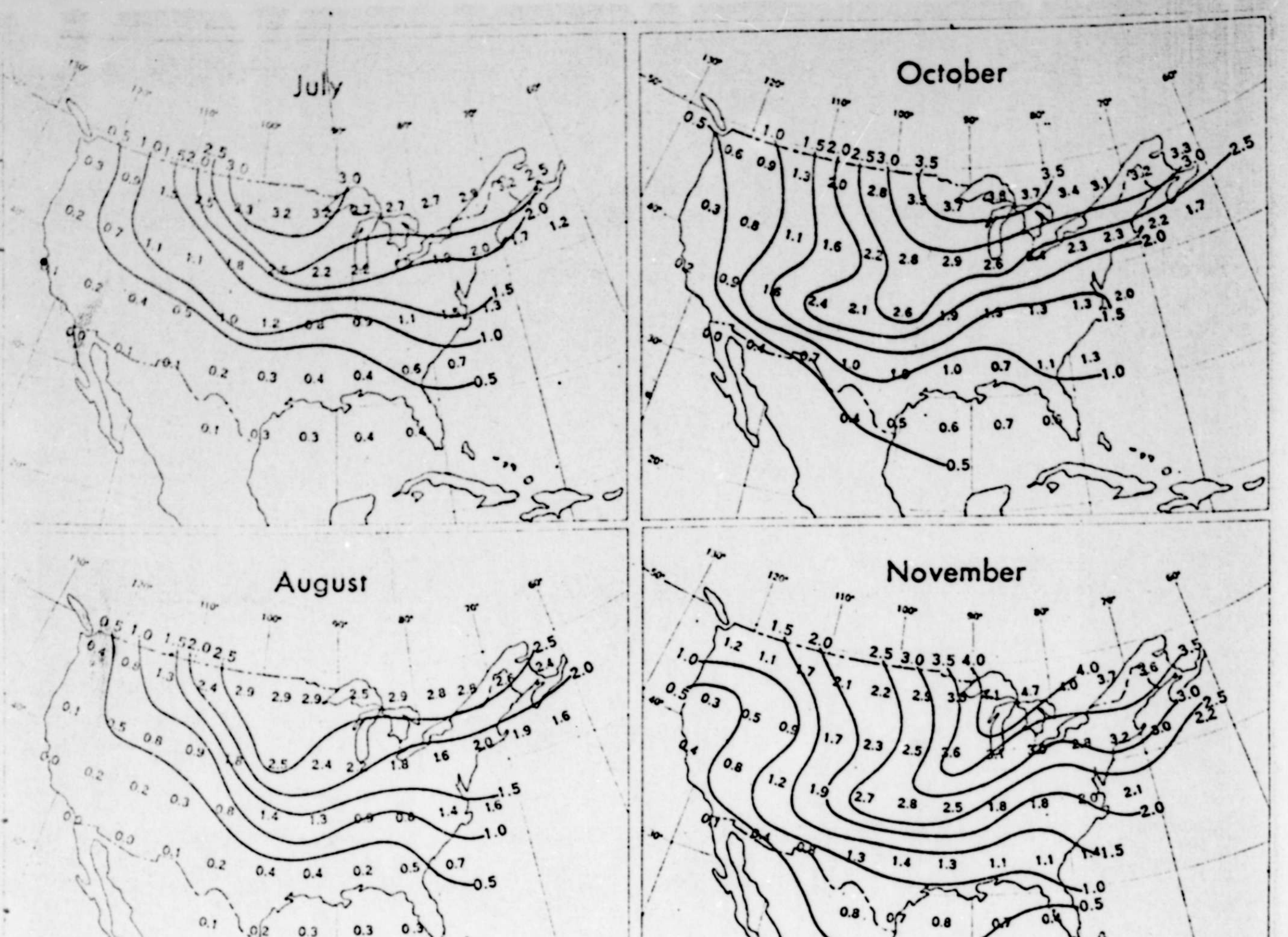


Figure 2-1b. Number of cyclones passing through each 5° latitude-longitude grid in the United States, by months, 1905-1954 (2).

Many of the continental type of cold fronts are weak and as they move southward along the east slopes of the Rockies, a strong diurnal variation in southward movement can usually be noted, i.e., the front is retarded during the daytime heating period then speeds up with the onset of the nighttime cooling. Possibly the cold air drainage from the mountain slopes is responsible for this acceleration. The diurnal variation is most pronounced on quasi-stationary fronts orientated east-west in the vicinity of Oklahoma. During the heating period such a front may even move northward due to the overrunning south winds dragging the cold air at the surface.

Continental cold frontal passages are often preceded a few hours at Tinker by a polar maritime frontal passage. Thus, a drier air mass moves over Tinker before the CP cold front arrives and as a result, the CP cold front causes nothing more serious than a wind shift to effect aircraft operations.

Warm frontogenesis (3) can occur in the Oklahoma area in winter when surface temperatures are in the range 25° F to 35° F and a slow moving cyclone develops in the eastern Rocky Mountain region. The south border of snow cover over the Oklahoma-Kansas region, if also present, is an added factor favoring warm frontogenesis. An occurrence of warm frontogenesis is depicted in the AWS Historical maps for 18 February 1952.

Records show instances about every year during summer or fall when tropical storms or hurricanes from the Gulf of Mexico or the Gulf of California recurve in a manner to bring an extensive cloud cover over Oklahoma. Generally, little precipitation occurs from these situations, but a notable exception was effected by hurricane "Carla" during mid-September 1961. Some other examples of these may be found in the AWS Historical Map Series for the first week of August 1955 when a hurricane moved northward over New Orleans and again the first week of October 1949, when a hurricane moved in over east Texas. The last week of August 1951 shows a case where a Pacific hurricane recurved into the Southwest United States to influence the weather over Oklahoma.

It may be noted from graphs in Section III, that most of the annual precipitation accumulates through the spring and summer seasons. This is also the thunderstorm period. During spring and summer, the approach of fronts, both polar maritime and continental types, serve to trigger off the greatest amount of thunderstorm activity in the form of pre-frontal squall lines. The greater portion of winter time precipitation results from moist air masses over-running a cold slow moving continental air mass lying over the Great Plains. This moisture may come in from the south at low levels or from the southwest at the higher levels, or both. Moisture advected over Tinker from the southwest above 700 mbs occur when deep cyclonic systems develop west of 100 degrees and move in the tracks described in J. J. George's Report No. 2(3).

Visibility at Tinker is generally good, averaging 10 miles or more 86% of the time. Radiation fogs are infrequent and of short duration since evaporation from the soil is weak at night-Tinker being in a dry subsoil region. Post-frontal fogs, however, occur in the winter months after the passage of slow moving cold fronts. The only other visibility restrictions other than precipitation, are blowing sand and dust which occur during drouths when strong winds in the so-called "dust bowl" stir up the dust to pollute an air mass which is subsequently advected into the Tinker area. Instances of this may be noted from weather records for 18 March 1955 and February 1956.

SEASONAL WEATHER

2. Winter Weather Controls

Winter and spring are the bad weather seasons in Oklahoma. Cold frontal passages of both cP and mP air occur with such frequency that the seasonal wind rose reveals almost equal percentage of north and south winds. Inflow of the strongly contrasting, warm, moist tropical air results in extremely active fronts between cP and mT air. The south south-east flow of mT air undergoes upslope motion from sea level to 1300 feet elevation at Tinker and continues to increase to 4,000 feet in the Texas Panhandle. As a consequence, return flow of the warm moist air following a cP outbreak brings wide areas of low stratus and fog. The returning warm moist air overruns the wedge of cool polar air and precipitation from the middle cloud deck aloft aids the formation of frontal fog and stratus. Moreover, the warm precipitation quickly transforms the shallow polar wedge into a moist air mass which rapidly becomes indistinguishable from the gulf air.

This overrunning rain pattern creates an extremely hazardous condition; falling as it does into colder air, it often results in sleet storms or a freezing type of precipitation at the surface. The more lasting snow covers at Tinker have been a result of a coating of sleet or ice following the snow fall.

The formation and spread northward of this fog and stratus gives closed (below GCA minimum) or near-closed conditions that often persist for 4 or 5 days at a time. Clearing usually is dependent upon the passage of a cold front and subsequent entrance of a polar air mass.

A cold frontal system comprising 3 air masses occurs with a low pressure center passing north of Tinker. The low stratus and rain of the tropical gulf air gives place to southwest winds and clearing skies in the warm, dry maritime polar air modified over the southern Rockies. This in turn is followed by a cold continental polar frontal passage with strong gusty northwest winds, a sharp temperature contrast, instability stratocumulus, and showers under the cold air aloft.

Occasionally, maritime polar air masses come over the mountains from the west. Normally a warm type occlussion will stagnate in the mountains while the upper cold front progresses unhindered, to regenerate east of the Continental Divide and become exceedingly active with thunderstorms, heavy rainshowers, and often hail, when it encounters the maritime tropical air over Texas and Oklahoma.

3. Spring Weather Controls

Spring represents a transitional period from winter to summer situations. Two distinctive spring weather situations are of interest. A stationary cP-mT front oriented southwest-northeast with a strong south southeast flow of moist air overrunning a north northeast flow of polar air over the Texas Panhandle, across Oklahoma, Kansas, and Missouri. Precipitation is intense and prolonged north of the frontal system. To the south, in the warm air, broken cumulus ceilings generally prevail. However, north of the front light rain, low stratus, and thunderstorms which accompany unstable waves along the frontal zone bring several days of poor weather. This frontal situation occurring as it does following the spring thaws produces floods in the midwestern regions. In late spring eastern Oklahoma and parts of the adjoining states receive more rainfall on the average than any other part of the country east of the Rockies. There is a decided tendency for squall lines to form in the warm air, oriented parallel to the stationary front through Texas. It is not unusual to expect some of the most intense local storms with these squall lines that are produced anywhere in the world. These lines move rapidly eastward 200 to 300 miles and then tend to dissipate. It is due to the above conditions that Tinker is included in "Tornado Alley".

The second situation is the extension of the Gulf stratus sufficiently far north to include Tinker in its northern fringe. The stratus occurs as a deck with ceilings varying from 900 to 1800 feet, and the tops generally not over 4500 feet MSL. Formation takes place near sunrise and dissipation or transformation to scattered cumulus usually occurs by 1000 LST. This stratus follows as the result of a prolonged south-southeast flow and is a product of both upslope and advective conditions. This stratus usually forms up until 15 June, then fails to penetrate this far north again until fall.

4. Summer Weather Controls

Tinker summer weather is dominated by the Bermuda High. Circulation is predominately south-southeast and moist in the first 6000 feet, becoming southwesterly and drier above 8000 feet. Scattered cumulus form in the afternoon, but seldom mature into thunderstorms. Turbulence becomes light to moderate below cloud decks in the afternoon. Surface winds may have a large diurnal variation in velocity, varying from 8 to 12 knots at night to 20 to 25 knots in gusts near noon. The early afternoon maximum indicates that the convective activity due to insolation plays a part in the increase in these winds. Turbulence is generally moderate at low levels and may extend to 8,000 to 10,000 feet MSL with these strong winds. The general pressure pattern for these winds is a trough along the lee of the Rockies, and the Bermuda High protruding over the southeastern states. A diurnal variation in direction as well as velocity is evident in the surface winds which are predominately south-southeast, but become south to south-southwest with the influence of the more southwesterly gradient winds.

Visibility is generally 7 to 12 miles, however, the visibility seldom exceeds 12 to 15 miles due to haze which is always present in the summer mT air - usually to an elevation of 6000 feet MSL. This haze becomes particularly bad when a cP cell stagnates over the midwest. In such a case, surface visibilities may be reported as 7 to 9 miles, while visibilities aloft are only 3 to 5 miles in a haze layer from 4,000 to 8,000 feet MSL. Blowing dust and smoke on infrequent occasions restrict the surface visibility, but are not of sufficient importance to be a hazard.

Occasionally a cell of Superior air from the southwest reaches the Tinker area and advances eastward. It will be accompanied by clear skies, extremely low relative humidity, and gusty southerly surface winds that may raise blowing dust as the system moves eastward.

Oklahoma becomes a region of frontolysis for both mP and cP fronts in the summer. The fronts become stationary and dissipate very often in the southern part of the state in early June and late August, and in the northern part of the state in the middle of the summer season.

Tinker lies in a belt that borders 3 different regions. The western part of the state and the Texas Panhandle has marked upslope with easterly winds, but generally has a dry southwest circulation in summer. The southeast part of the state has sufficient moisture to allow summer convective thunderstorms, somewhat accentuated by the orographic effect of the Ozark and Ouachita Mountains. The zone of nocturnal thunderstorm activity is generally confined to the north of Oklahoma.

Thunderstorm activity includes all types in the Tinker area with the exception of orographic. However, most thunderstorm activity in summer is associated with passage of a weak cold front. High-level night thunderstorms occur infrequently, but the presence of a weak front to the south of Tinker and the advection of cold air aloft into this area are conditions favorable for this occurrence. (See example 19-20 Aug 1943.)

The mean number of thunderstorm days (4) at Oklahoma City is tabulated as follows versus the percentage frequency of thunderstorm occurrence based on hourly observations at Tinker AFB:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Thunderstorm Days-Okla City	*	2	3	6	9	9	7	6	4	3	1	1
Percentage of Occurrence-TAFB	0	.5	.7	1.5	3.8	2.7	2.0	1.2	1.0	.5	.2	.1

*less than one

The above averages appear to conflict as to the peak of the thunderstorm season. This is due to the method of defining a thunderstorm day, i.e. a thunderstorm starting before midnight and ending past midnight is counted twice. Thus, since the tendency is for thunderstorms to occur more often late at night with the approach of summer, the data is biased to show more individual thunderstorm periods than actually occur-especially during the summer. Operational experience has clearly established May as the peak of the severe weather season. This fact is evident in two ways: (1) Records show that the base weather station issues and verifies the maximum number of thunderstorms forecasts for Tinker during May (2) Records show that the AWS Severe Weather Warning Center has included Tinker in severe weather areas most often during May.

5. Fall Weather Controls

Fall is a transitional period between winter and summer weather situations. The mT circulation of the Bermuda High generally moves southeastward and mP and cP pushes become more numerous. Light ground fog and stratus become more prevalent in the mornings, while frontal passages become increasingly more of a forecast problem.

The average date of the first frost in November 6 at Tinker, but the first freeze has occurred as early as October 7. Approximately 60% of the time the first frost will occur between October 31 and November 15.

Snow and freezing precipitation do not usually pose much of a flight hazard during this season. Very few cases of snow fall have ever been recorded at Tinker during the month of October, and only about every other year does snow occur at Tinker during the month of November.

An increase in the pressure gradient in this area is reflected in stronger surface winds and associated low level turbulence. The direction of the wind is still from the south-southeast a majority of the time, but the presence of northerly components increase with the increase of mP and cP frontal passages.

S E C T I O N III

CLIMATIC AIDS

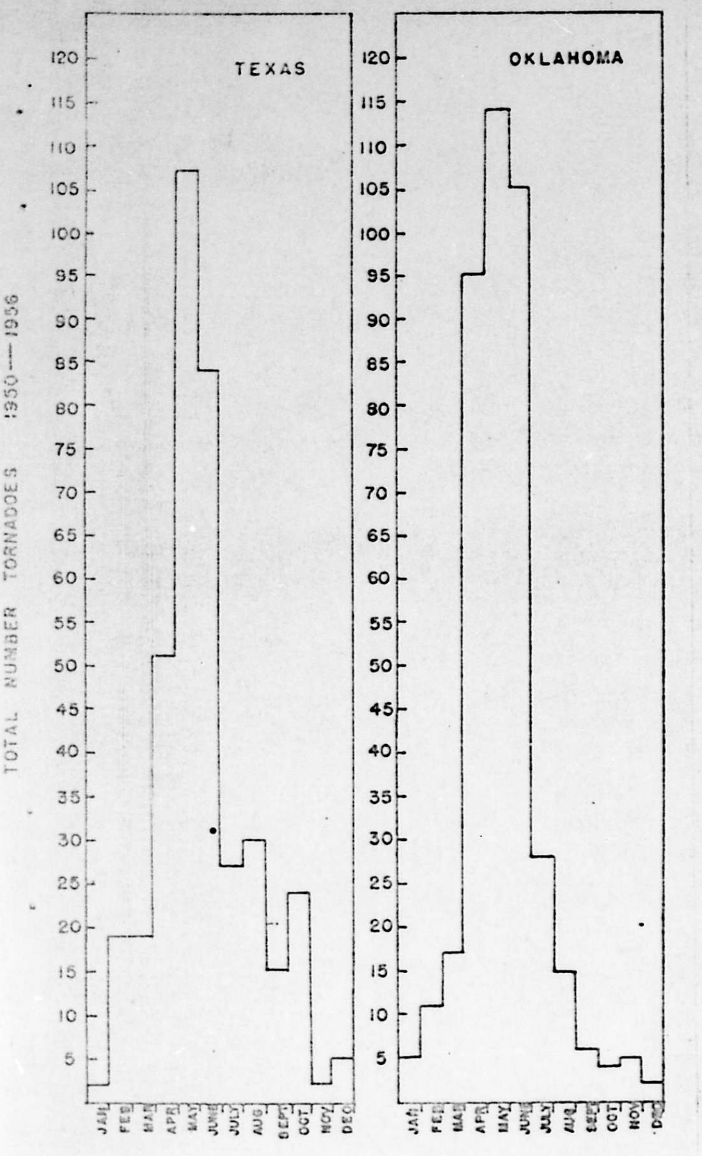
TINKER AIR FORCE BASE, OKLAHOMA

1. Tornado Characteristics in Oklahoma

During the period of 1950-1956 an average of 458 tornadoes per year occurred in the United States. Of this number, Oklahoma averaged a total of 68 tornadoes per year-second only to the state of Kansas. The data portrayed in the figures giving a monthly breakdown of occurrence and of seasonal occurrence by the hour were obtained from Climatological Data, National Summary (7). While the figures need little interpretation, the following background will help establish the validity of the information presented.

Every effort was made by the author to include only those tornadoes which actually touched the ground. Funnel clouds aloft were not included because of the more likely chance of mistaken identity. When a report indicated the occurrence of several tornadoes but gave no exact number, the number "two" was arbitrarily used as the number of tornadoes. The time (CST) of the first report of a tornado was used in the hourly distribution data. All tornadoes which had no definite time determinable were placed in a miscellaneous category in the hourly tabulation.

In addition to the above described figures, two figures portraying the geographic distribution of tornadoes in Oklahoma and in the United States and the number of tornadoes reported within 60 miles of Air Force Bases during the period 1920-1949 (9) are included. A slightly different figure portraying the geographic distribution is included in the Weather Bureau manual on forecasting severe storms (10), but it is the opinion of the author that the chart included with this summary is valid since a more detailed analysis was used in its preparation.



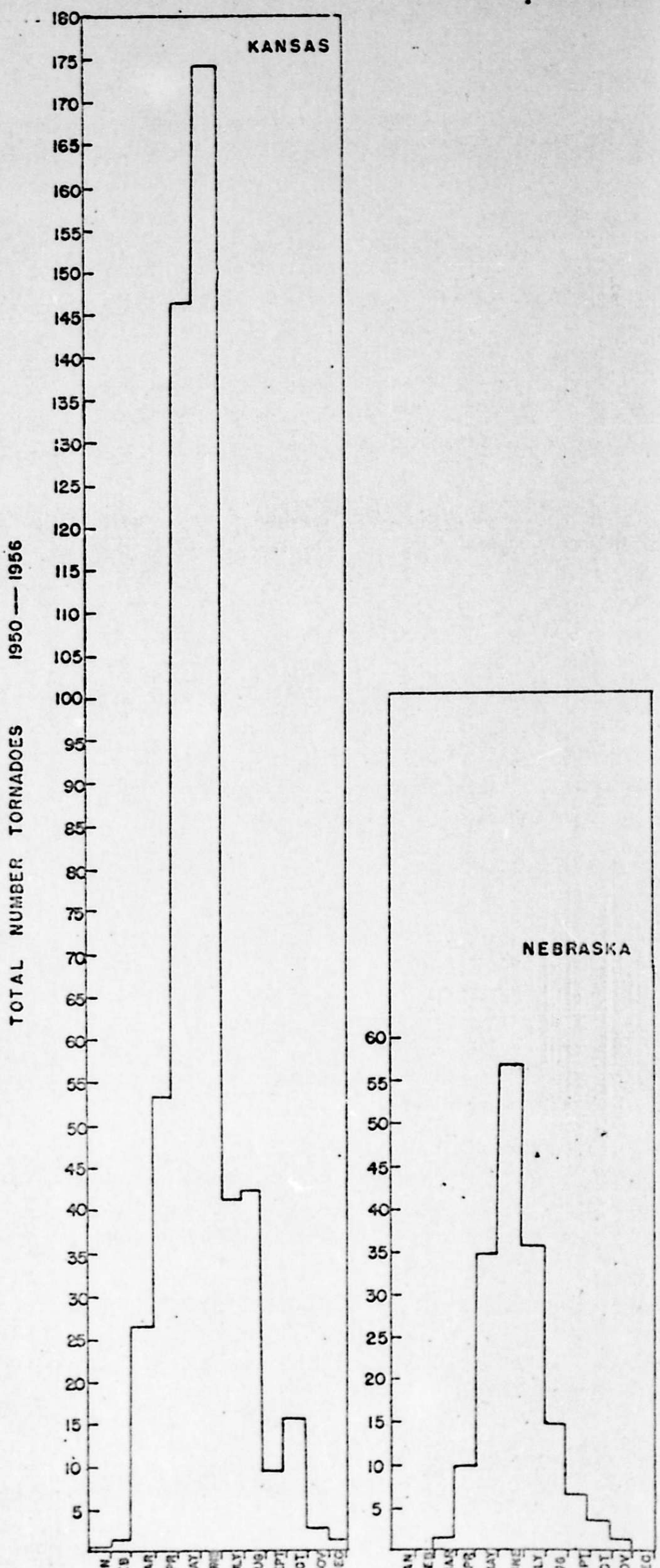


Figure 3-1. Total Number of Tornadoes by the month in Oklahoma and adjoining states along "Tornado Alley" for the period 1950-1956 (7).

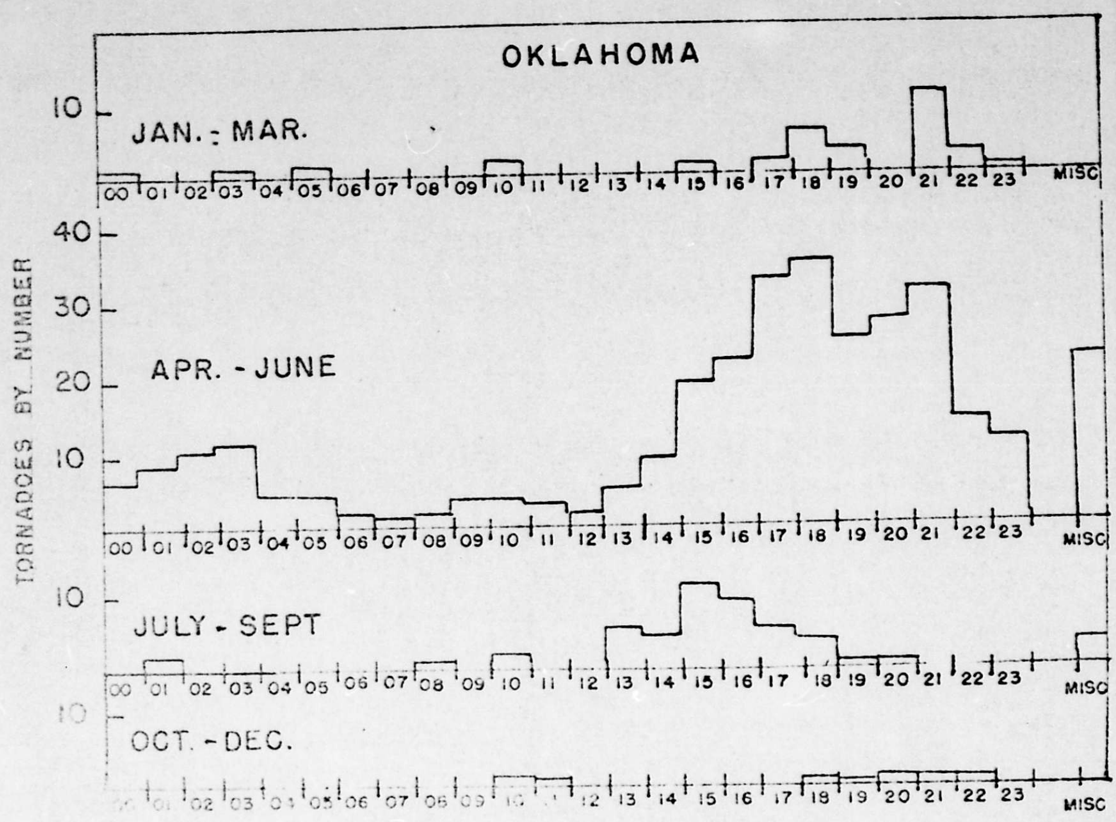


Figure 3-2. Tornado Occurrence by the Hour for Oklahoma, 1950-1956 (7).

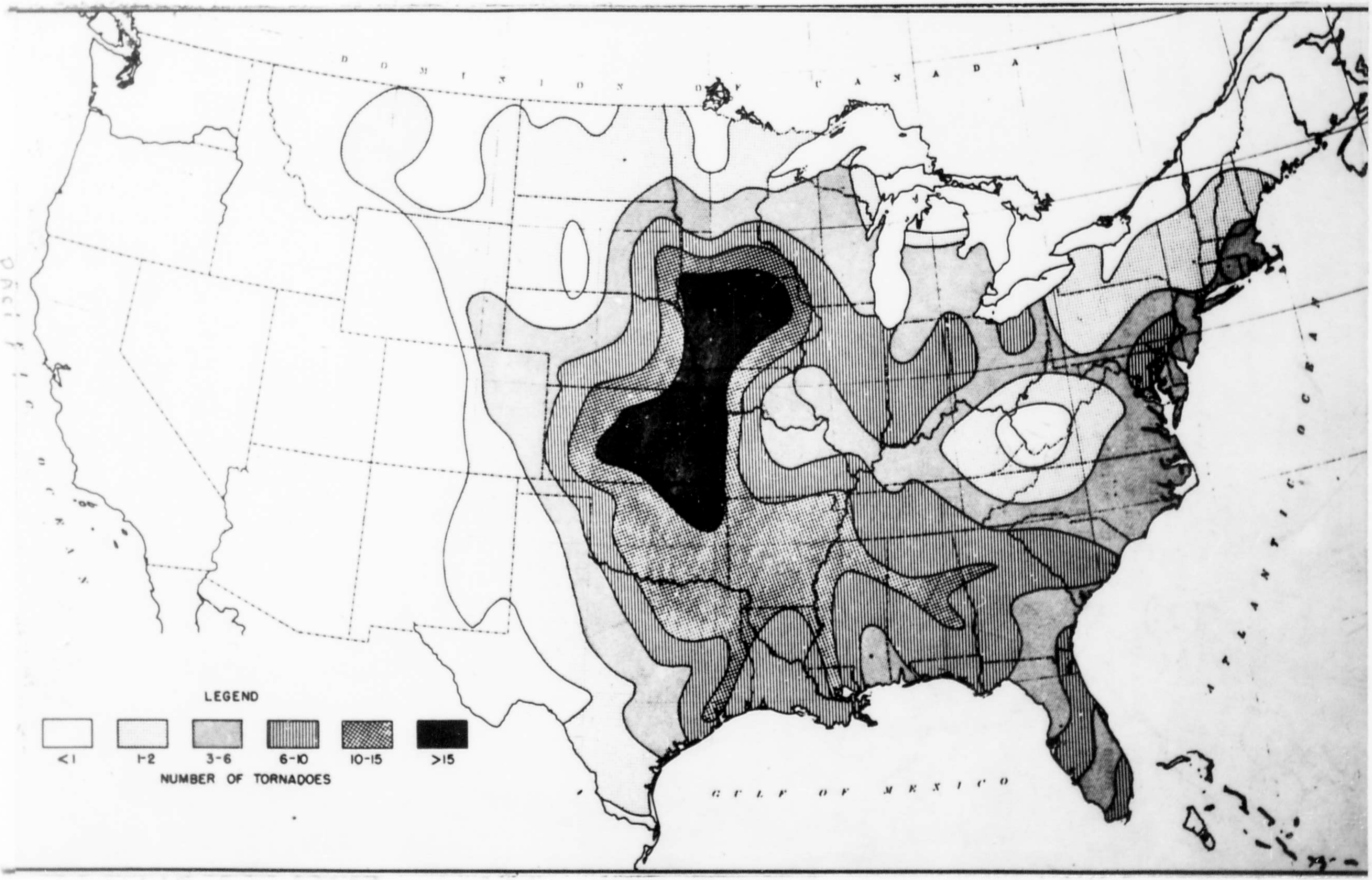
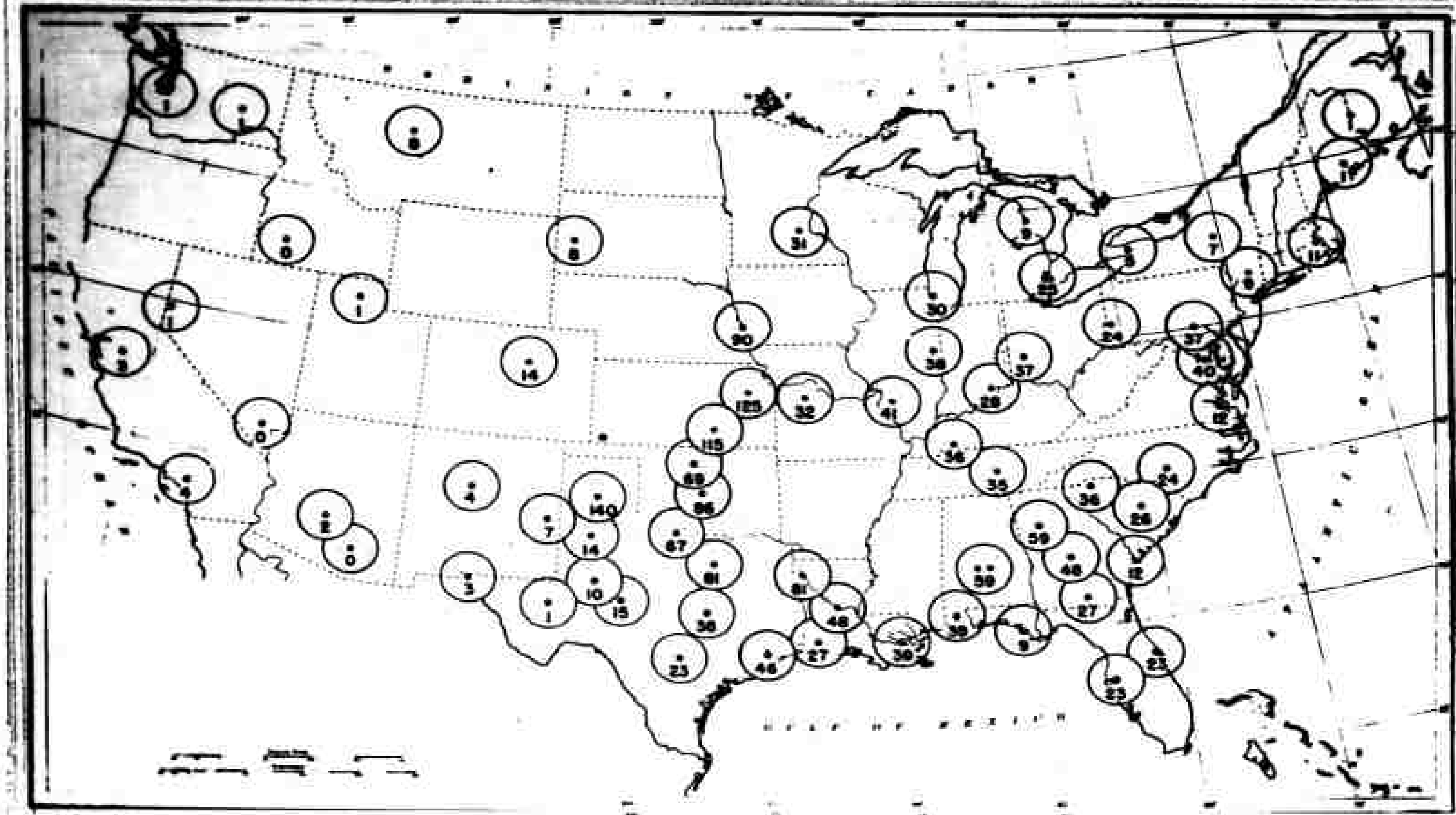
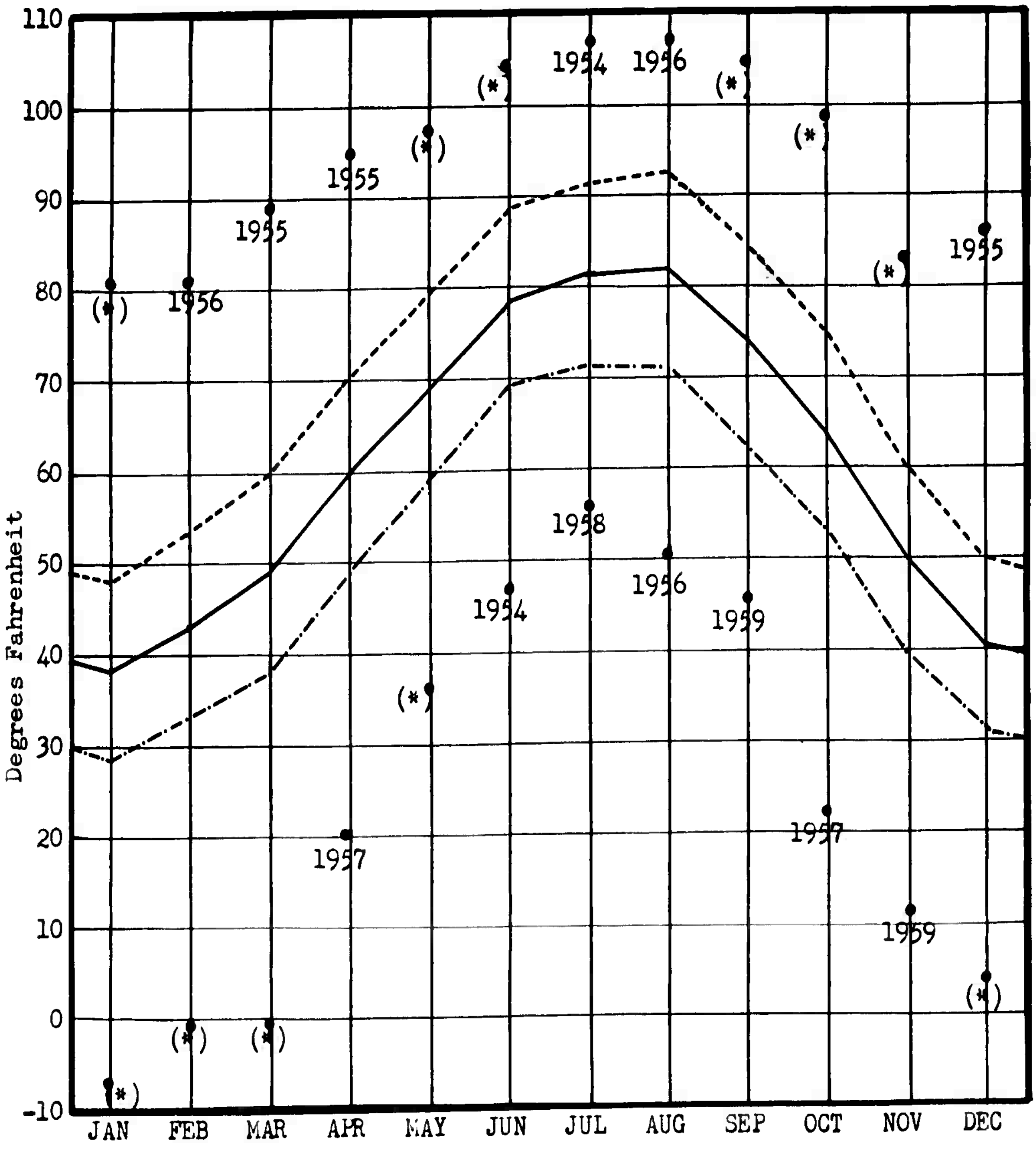


Figure 3-3. Total Number of Tornadoes per 50-mile Square Reported in the Period 1920-1949 (9)



3-4. Tornado Occurrences within ... (S)



Graph 1. The temperature regime, means and extremes, by the month at Tinker AFB, Oklahoma. Data for mean temperatures extracted from Uniform Summary of Surface Weather Observations for the period December 1942 to January 1946, and September 1946 to September 1953. Extreme temperatures are from USWB records and TAFB records from 1921 and 1942 respectively through December 1960.

Mean Yearly Temperatures:

71.0°F - maximum

60.8°F - mean annual

50.6°F - minimum

Legend:

.... mean maximum temperature
_____ mean temperature
_._._ mean minimum temperature
• extreme temp. and date
(*) date not determinable

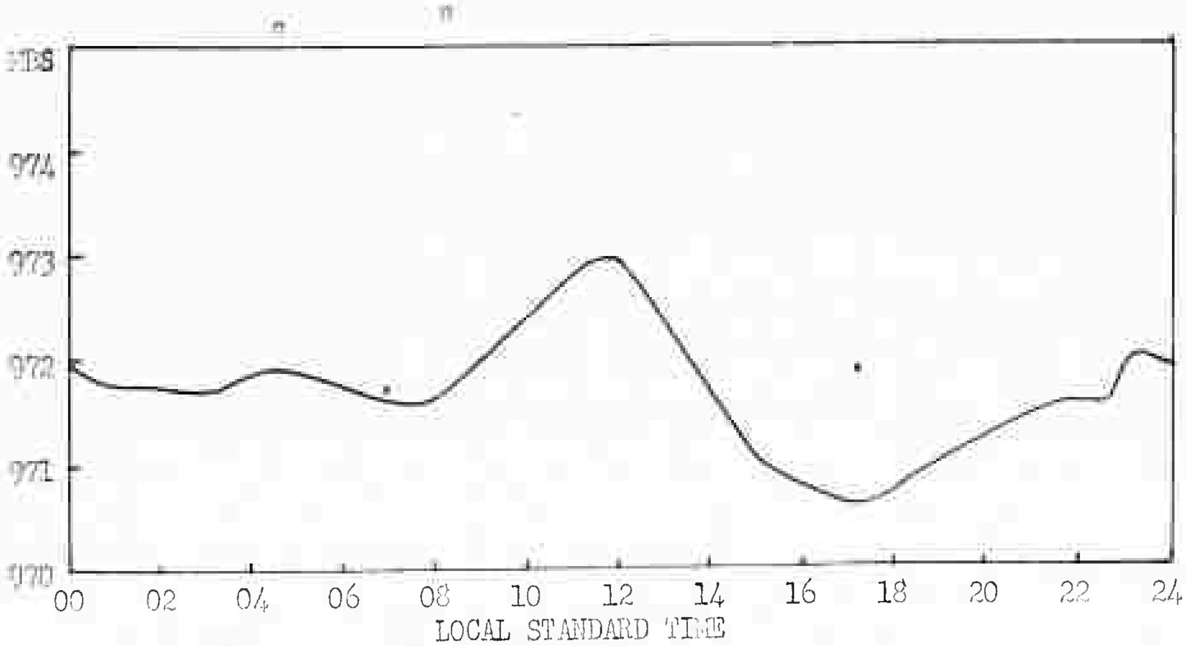
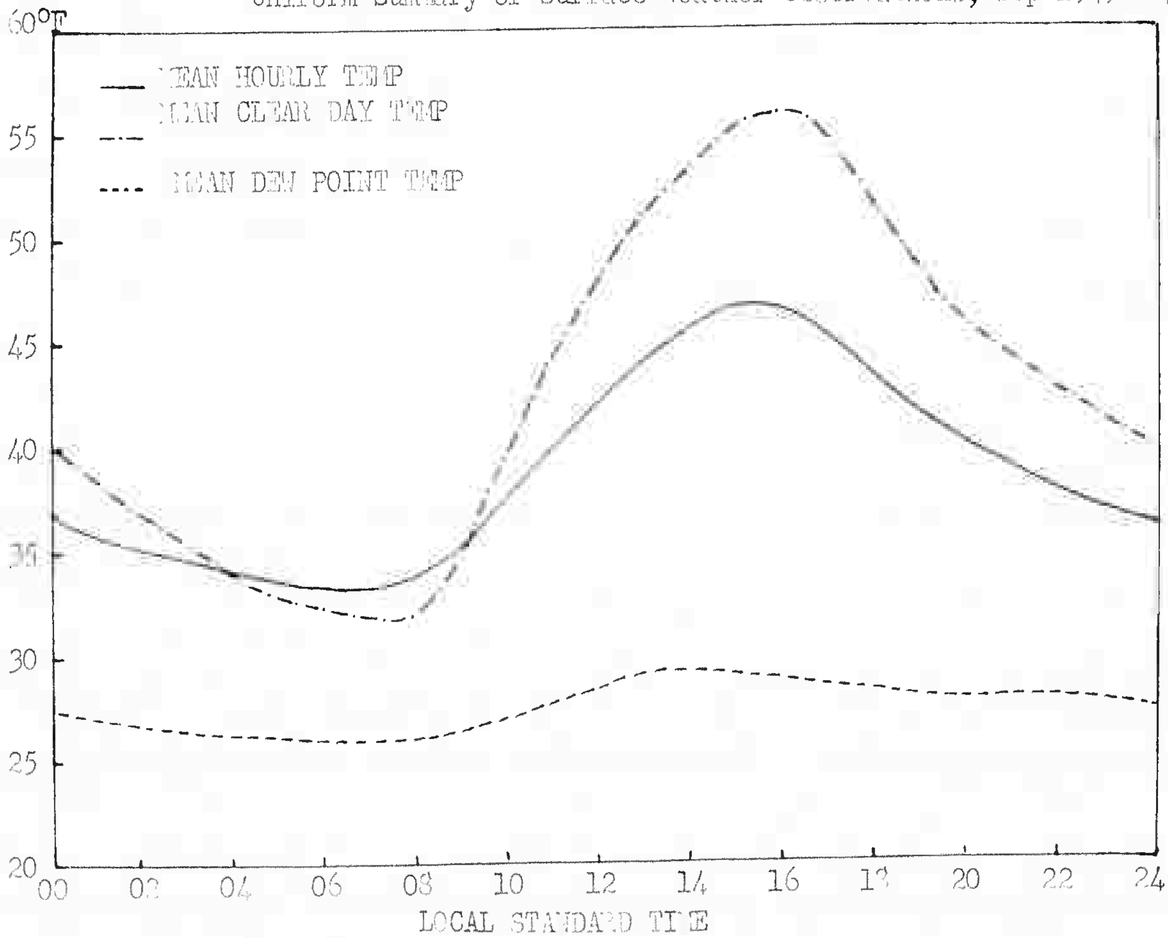


Figure 3-6a. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940).

JANUARY

Figure 3-6b. Mean Temperatures and dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep 1949-Aug 1959.



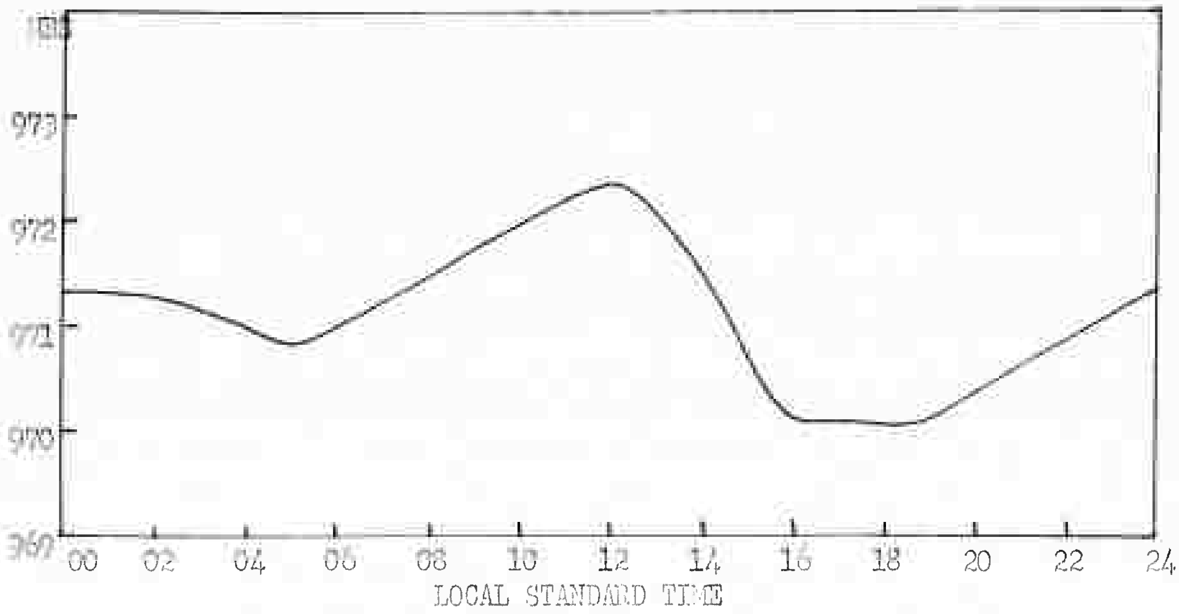
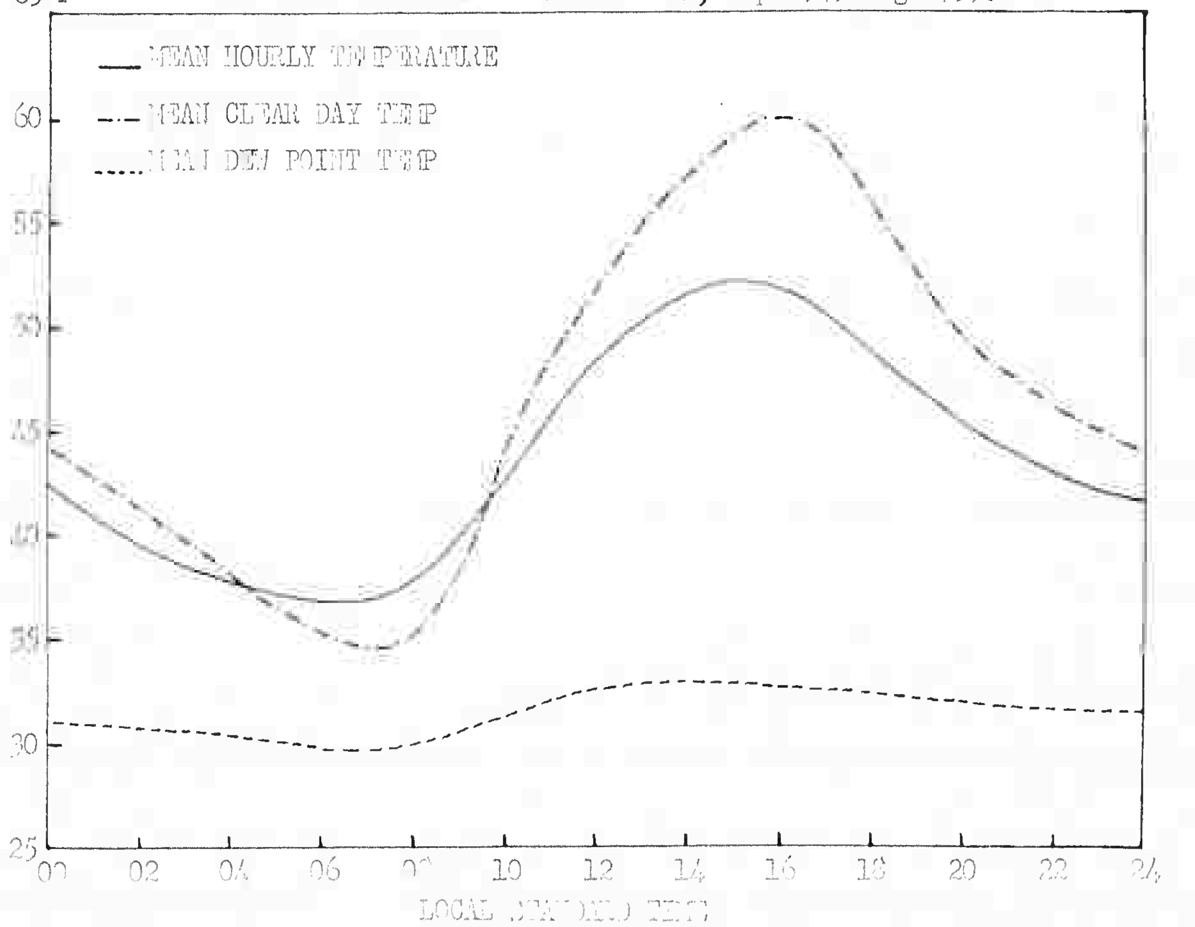


Figure 3-6c. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940)."

FEBRUARY

Figure 3-6d. Mean Temperatures and dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep-1949-Aug 1959.



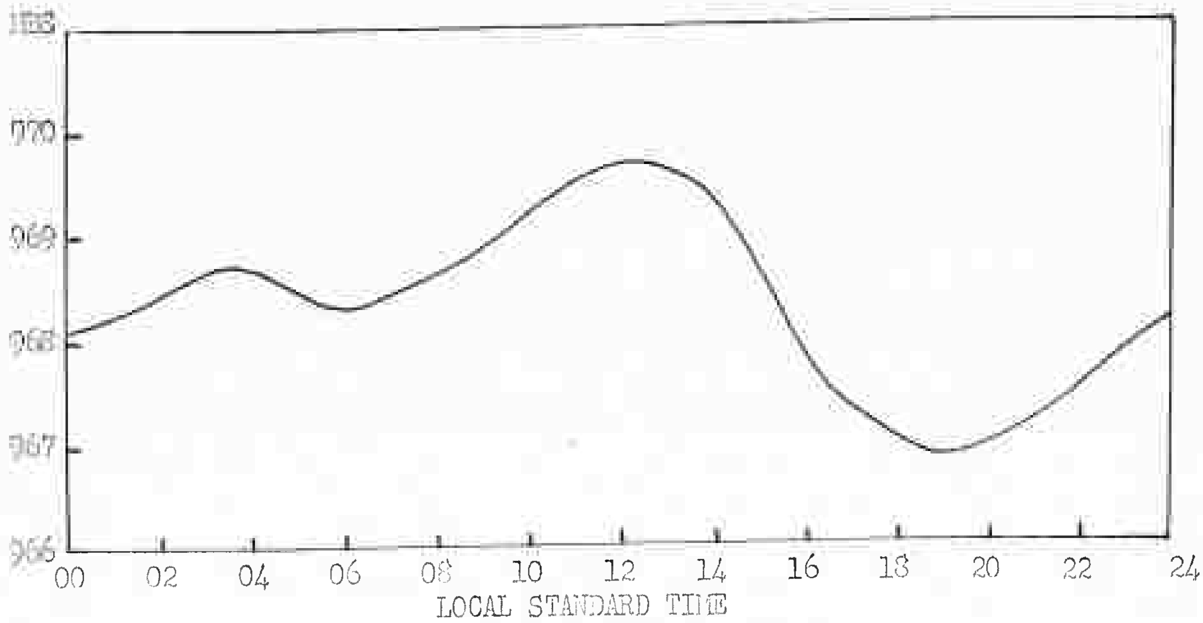
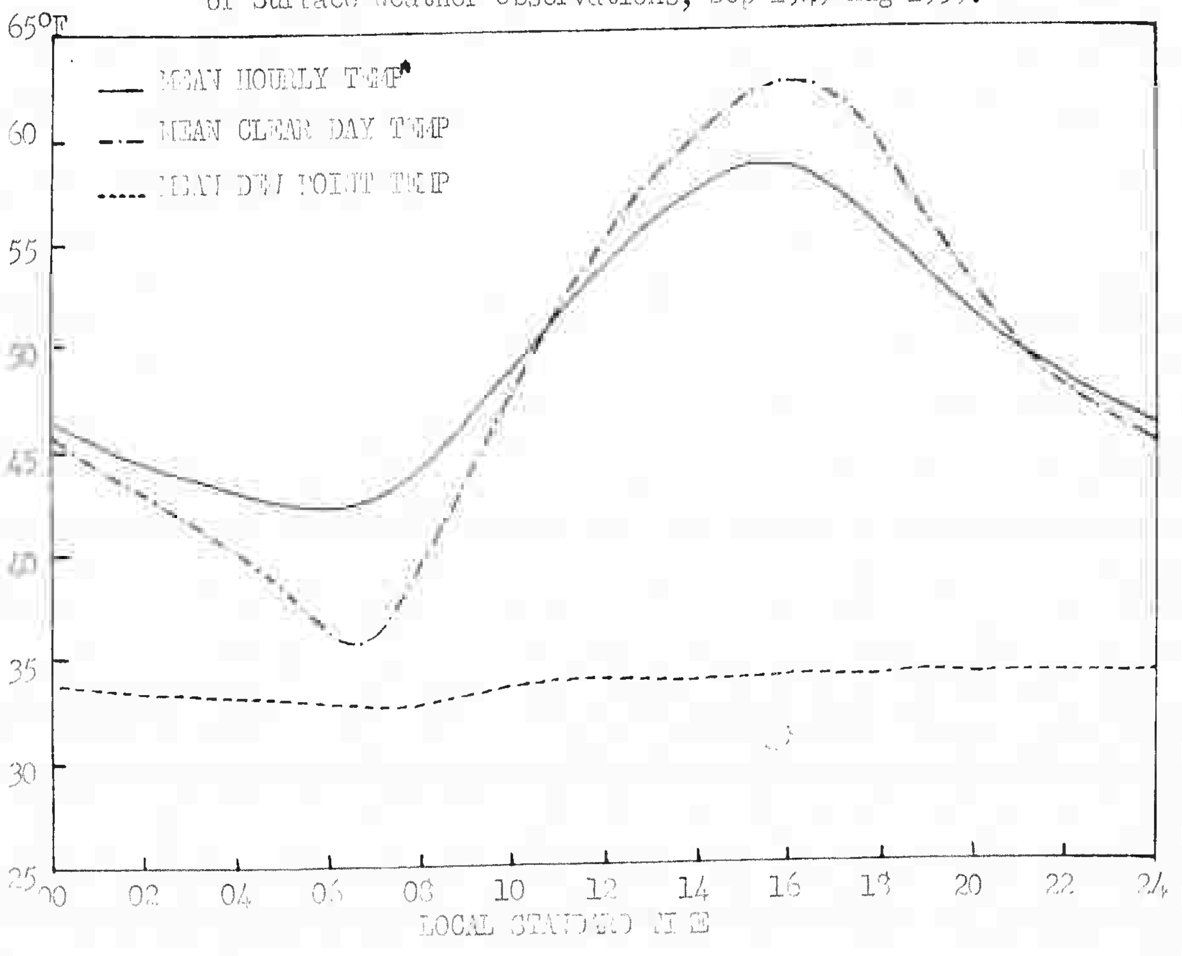


Figure 3-6e. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940)."

MARCH

Figure 3-6f. Mean Temperatures and dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep 1949-Aug 1959.



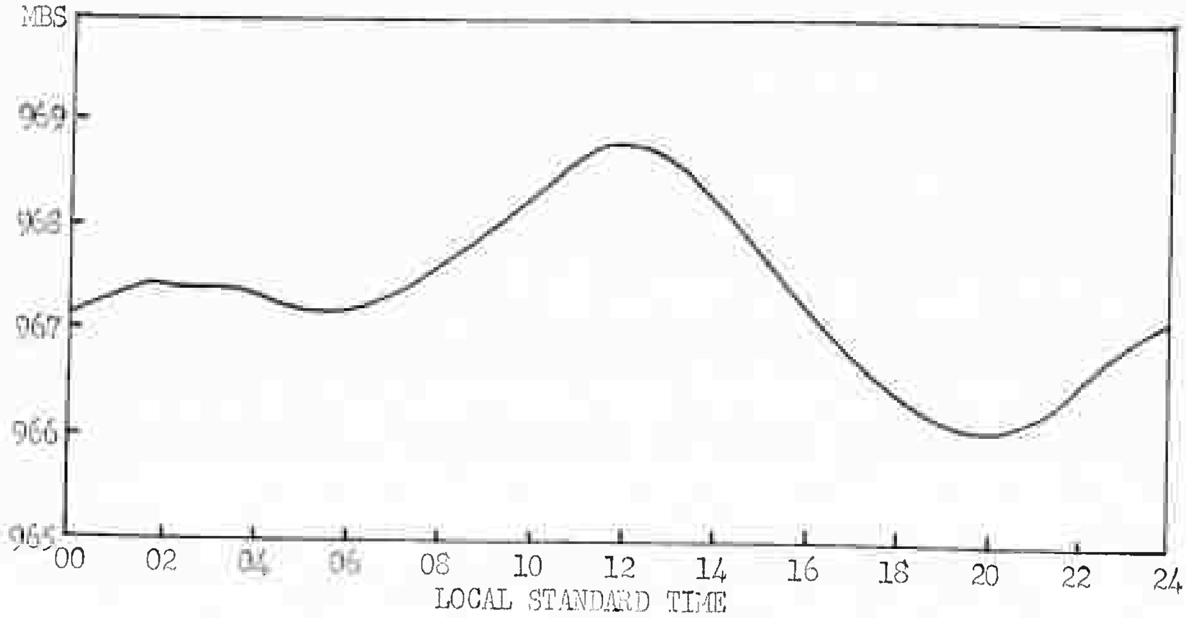
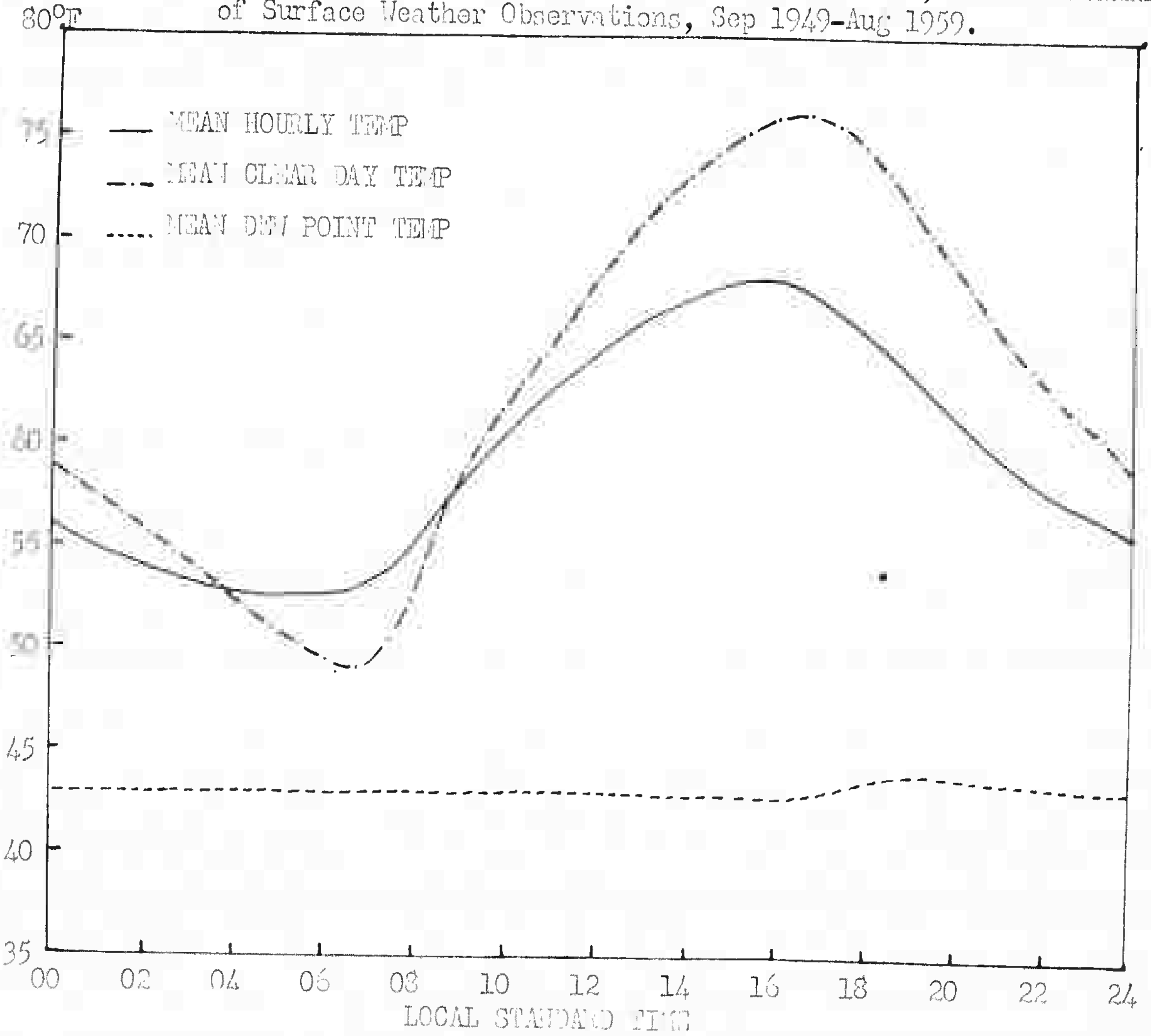


Figure 3-6g. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940)."

APRIL

Figure 3-6h. Mean Temperatures and dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep 1949-Aug 1959.



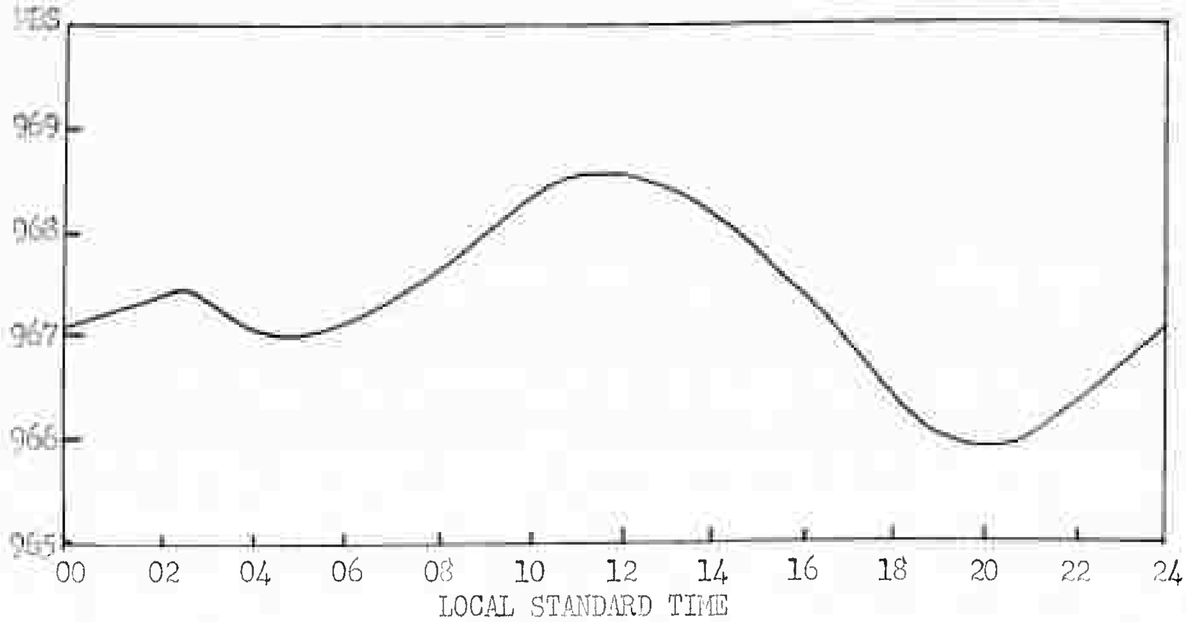
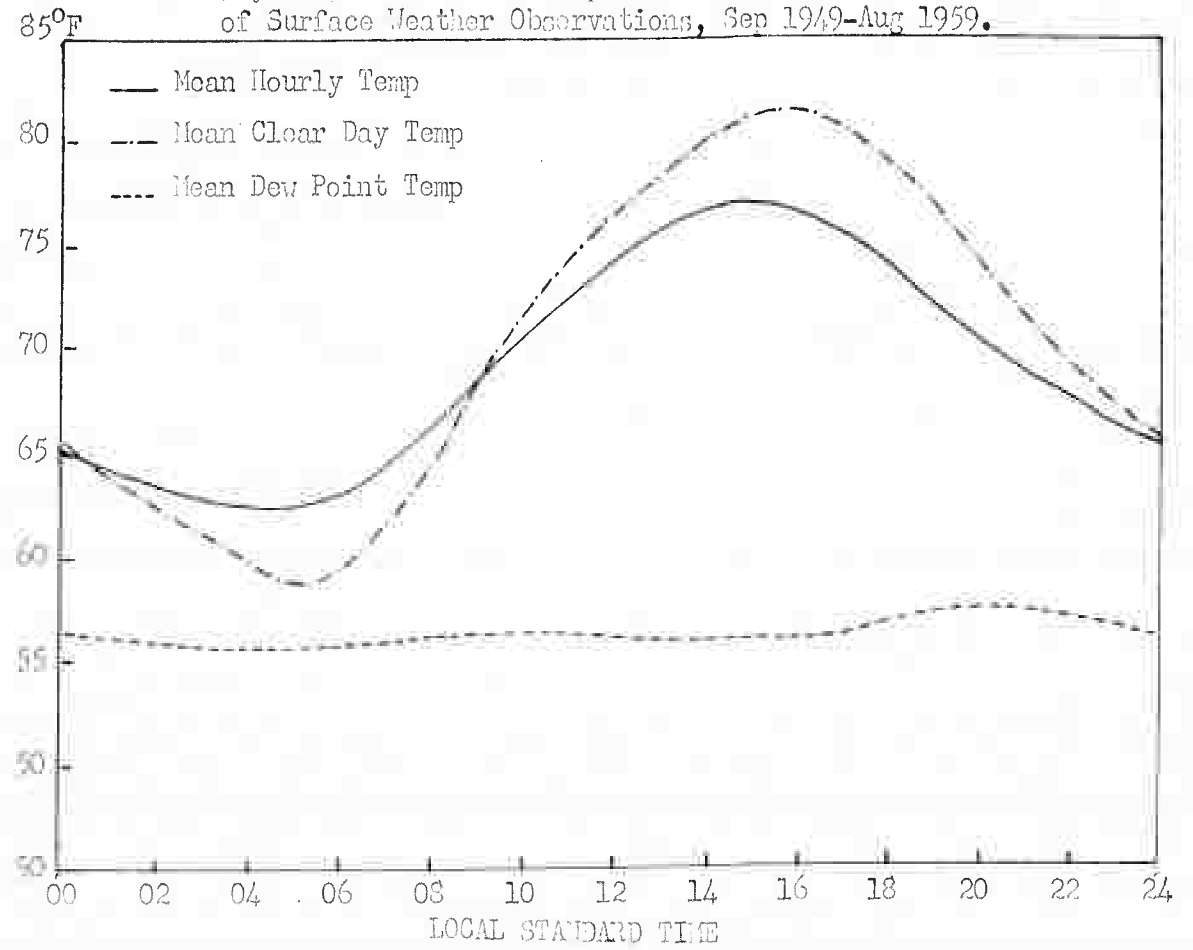


Figure 3-6i. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940)."

MAY

Figure 3-6j. Mean Temperatures and dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep 1949-Aug 1959.



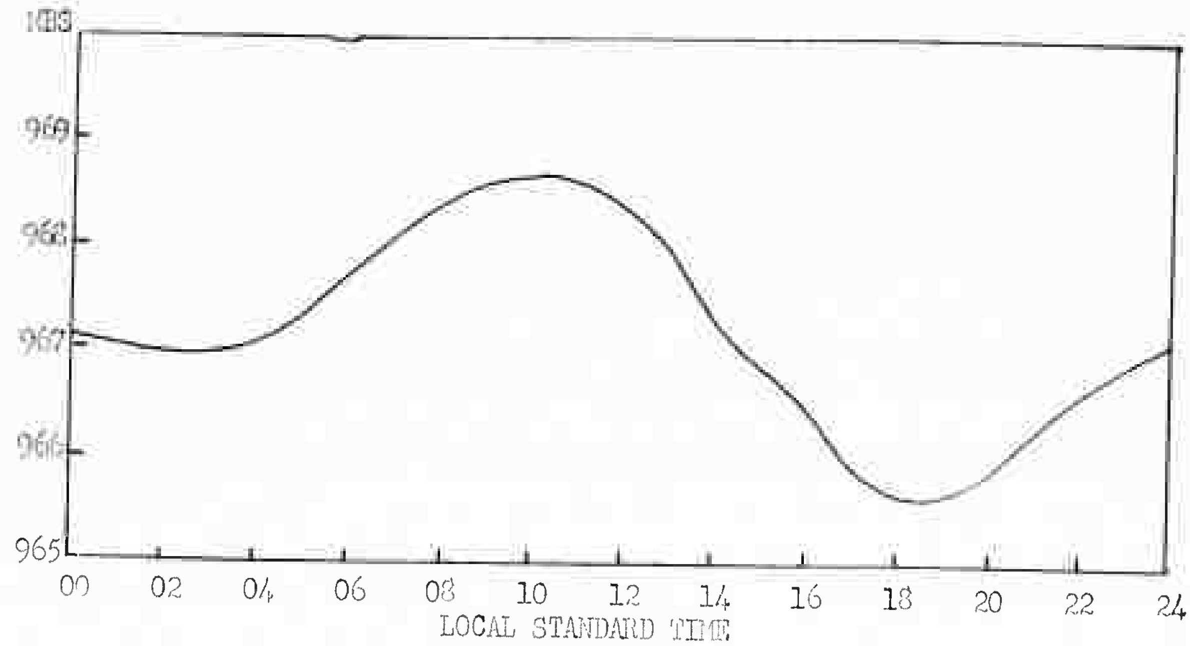
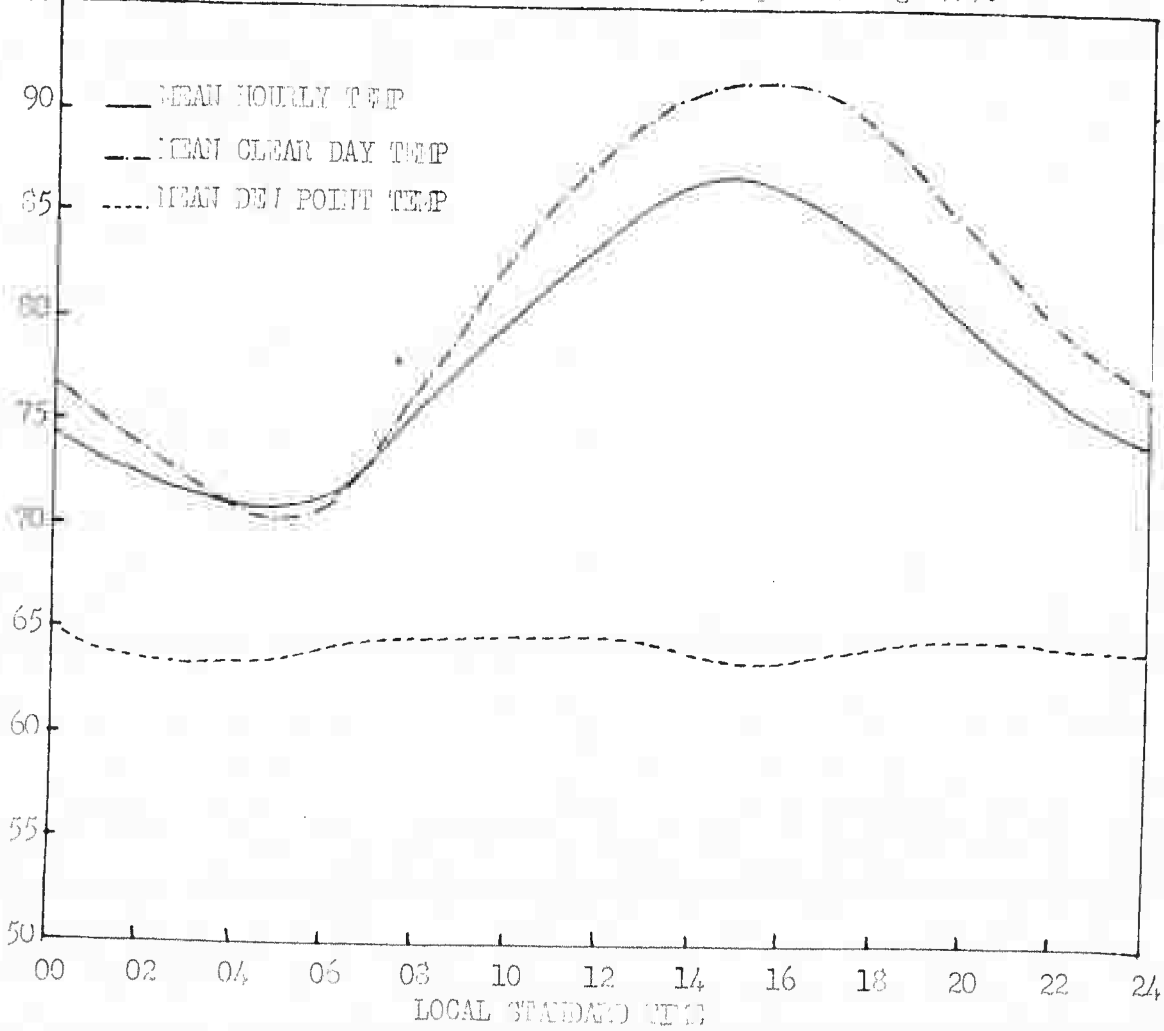


Figure 3-6k. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940)."

JUNE

Figure 3-6l. Mean Temperatures and dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep 1949-Aug 1959.



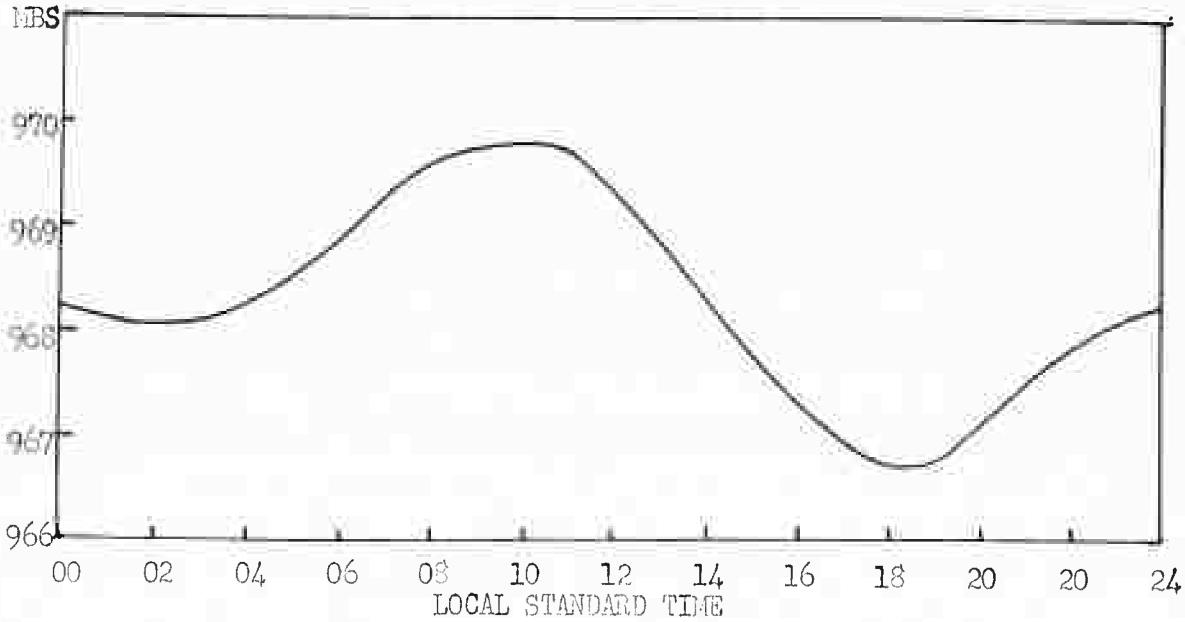
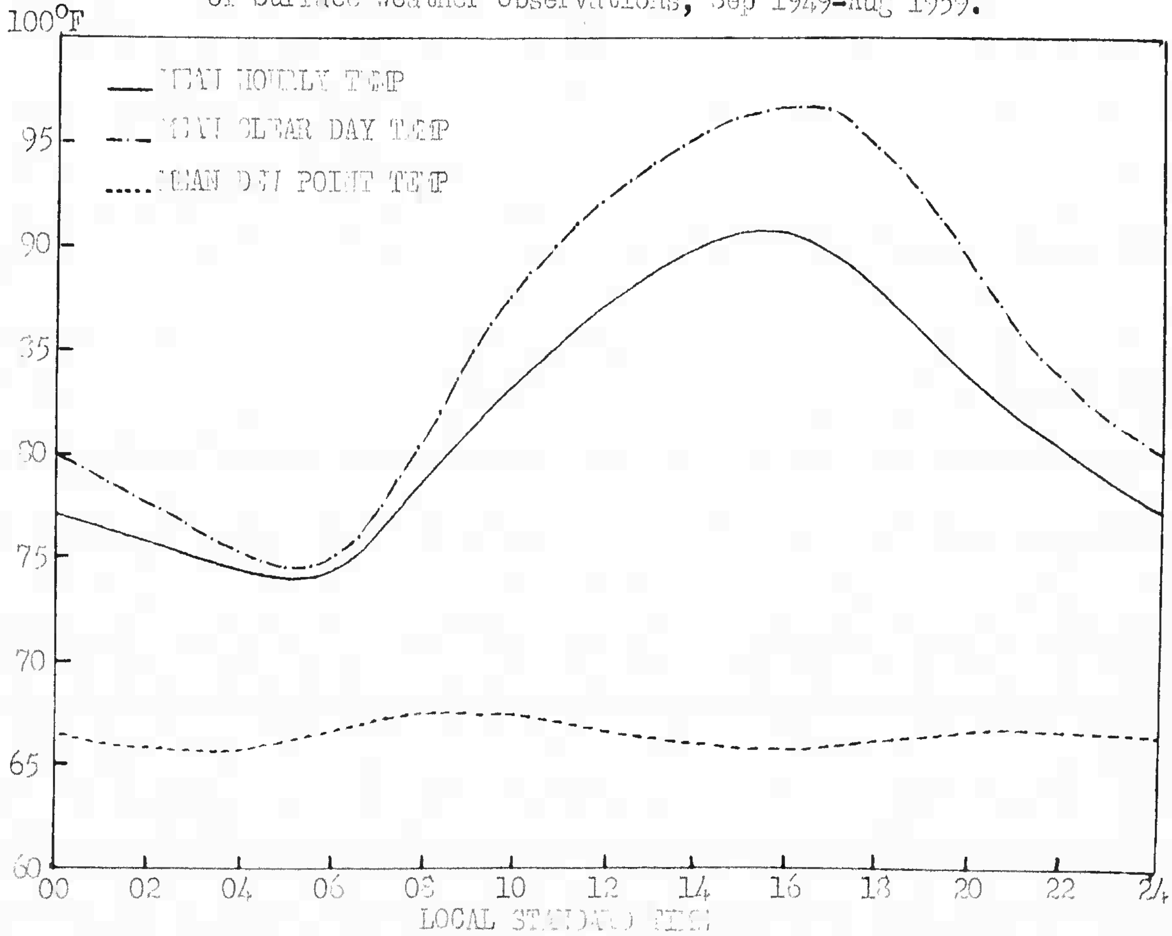


Figure 3-6m. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940)."

JULY

Figure 3-6n. Mean Temperatures and dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep 1949-Aug 1959.



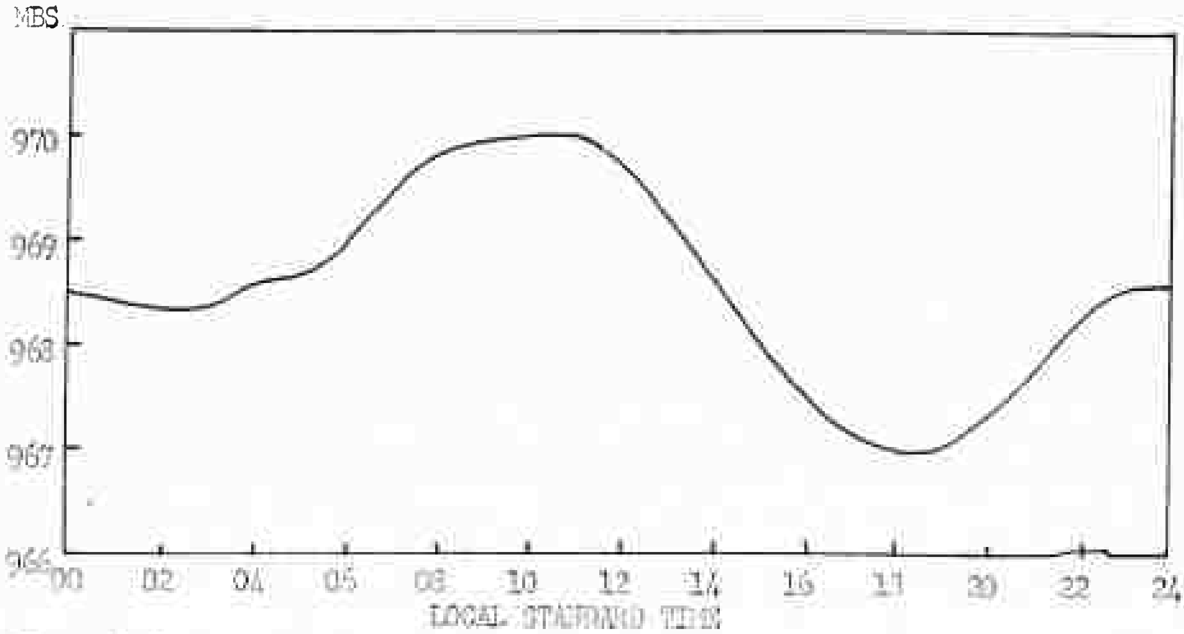
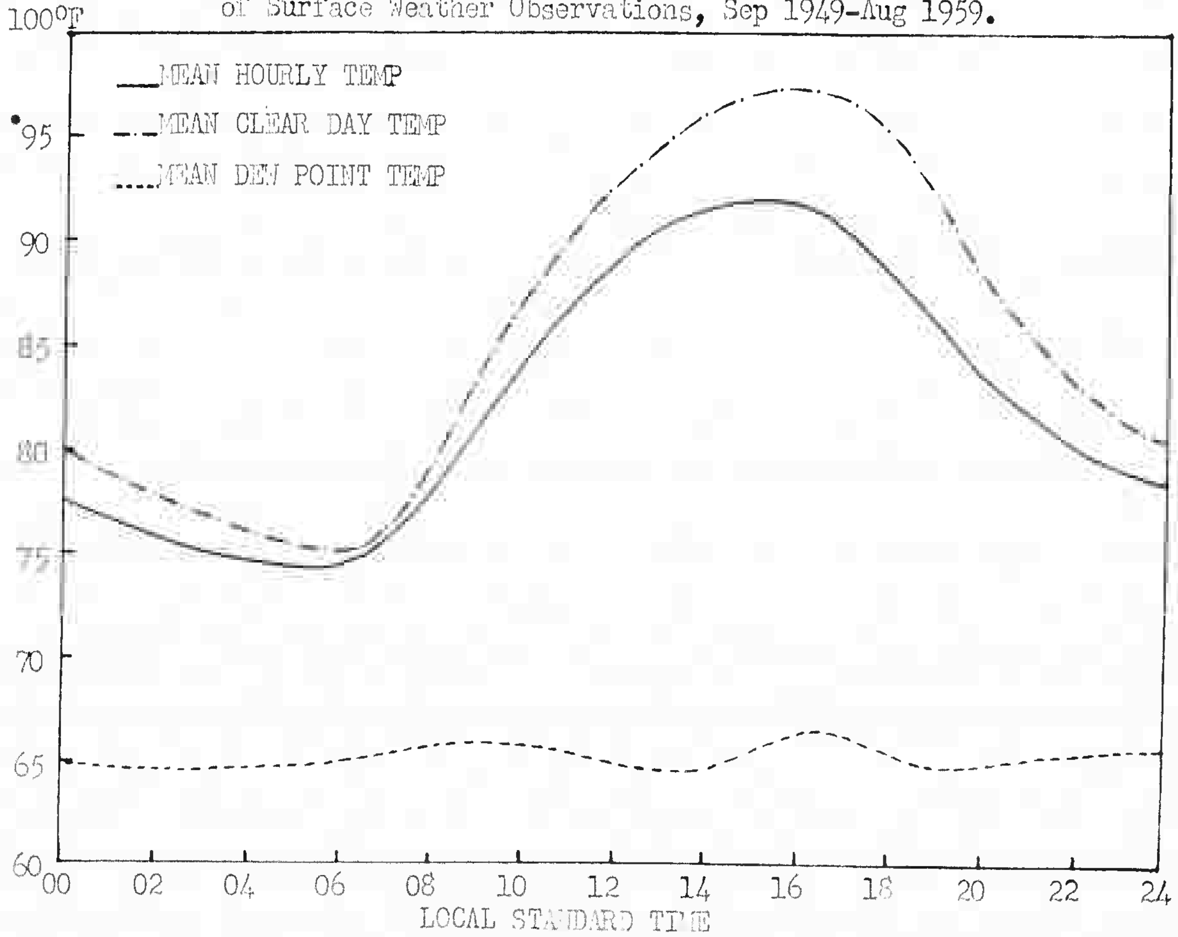


Figure 3-6o. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940)."

AUGUST

Figure 3-6p. Mean Temperatures and Dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep 1949-Aug 1959.



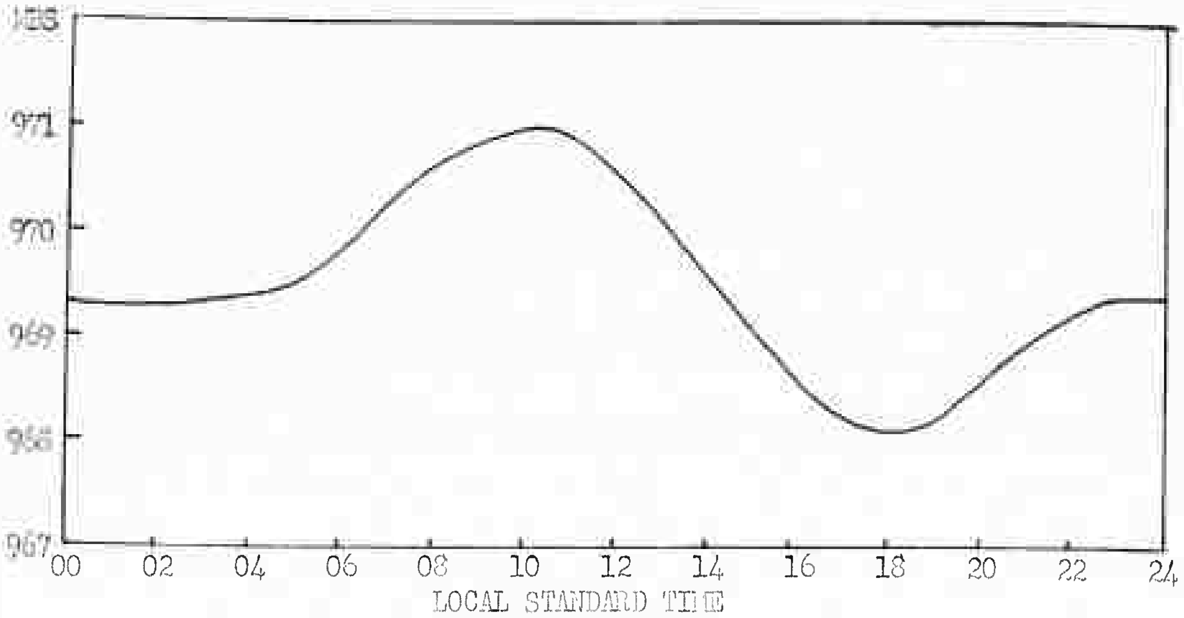
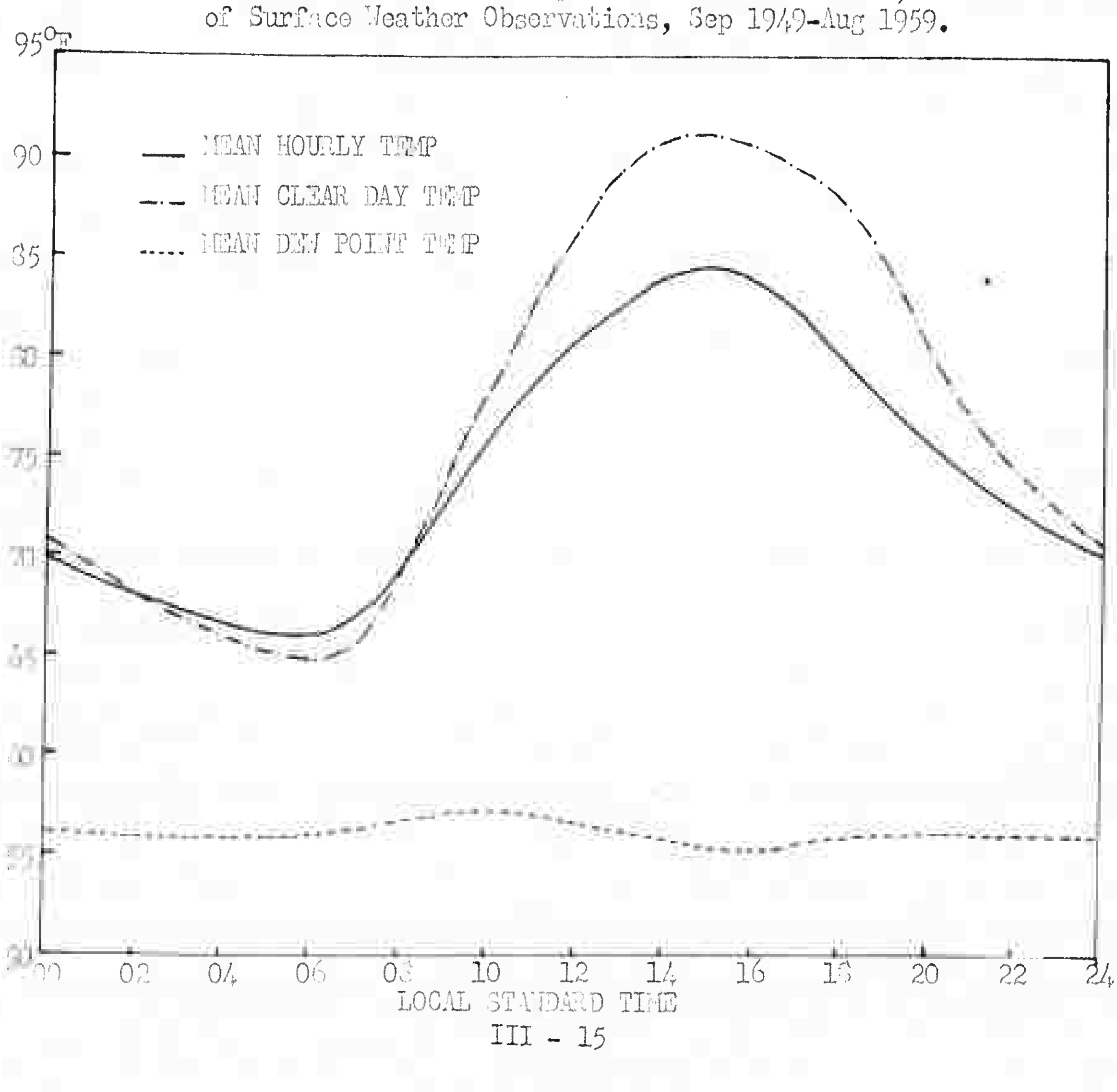


Figure 3-6q. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940)."

SEPTEMBER

Figure 3-6r. Mean Temperatures and dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep 1949-Aug 1959.



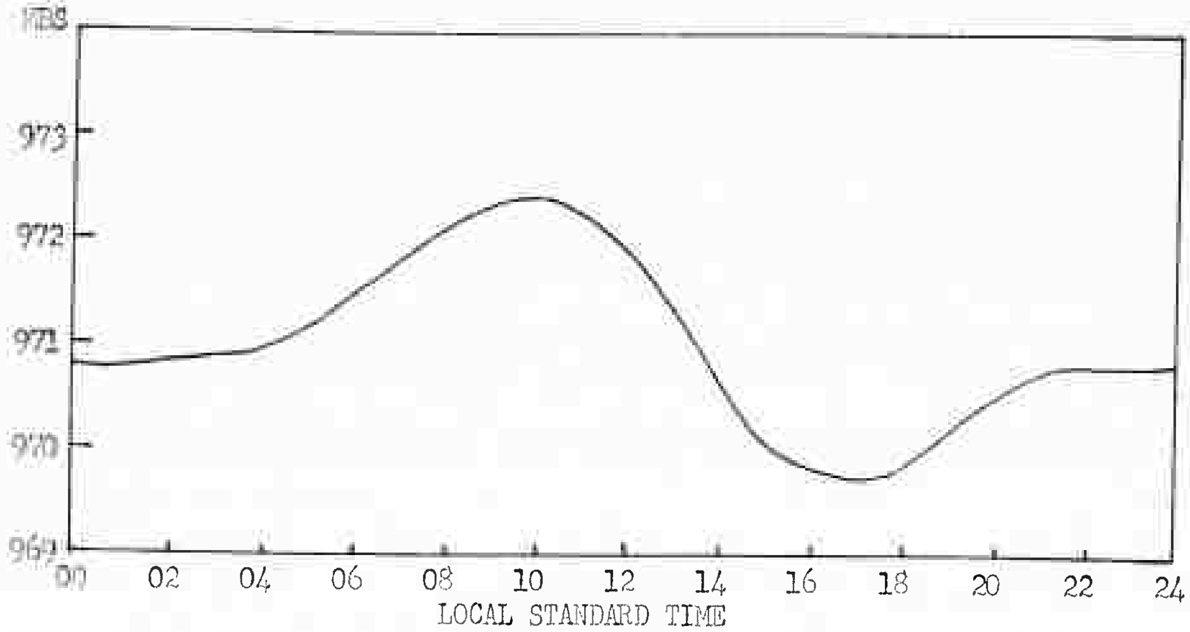
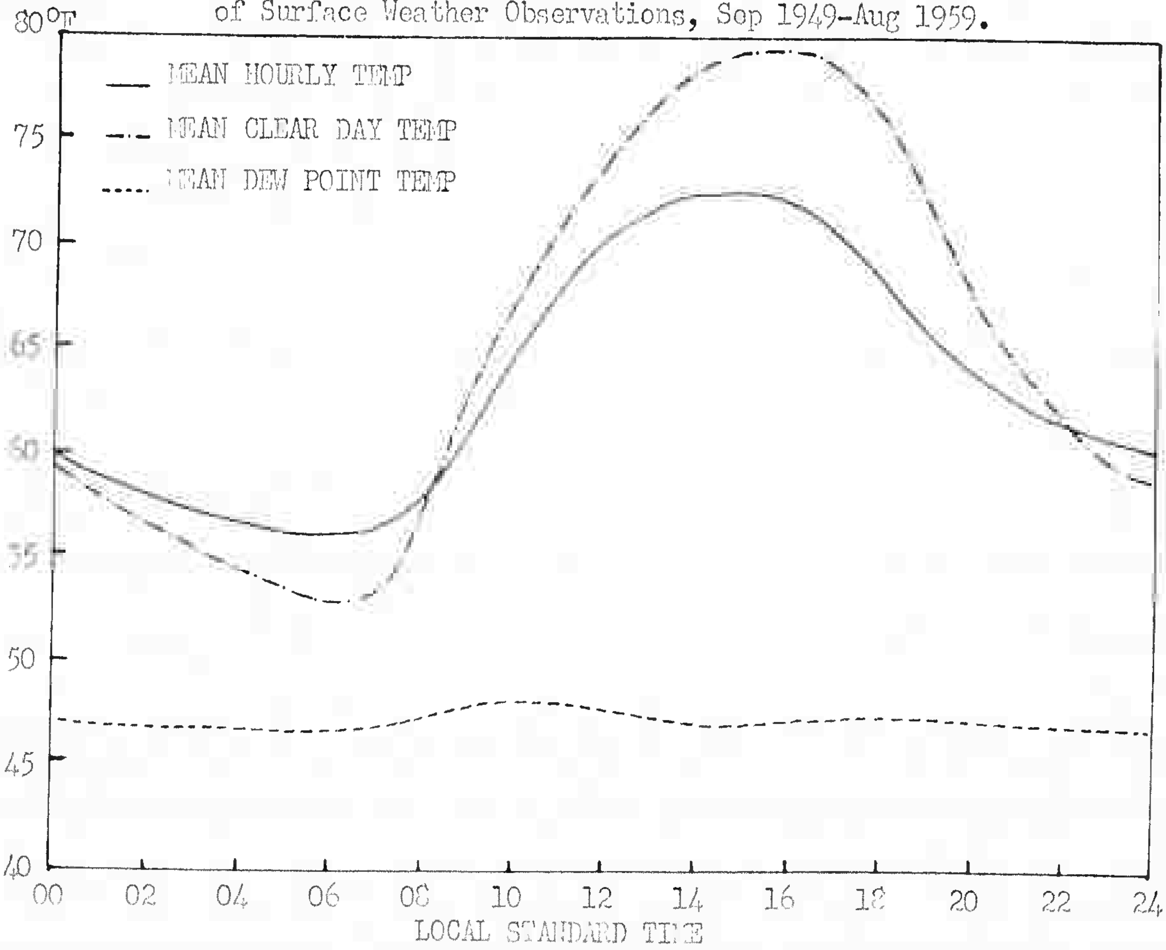


Figure 3-6s. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940)."

OCTOBER

Figure 3-6t. Mean Temperatures and dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep 1949-Aug 1959.



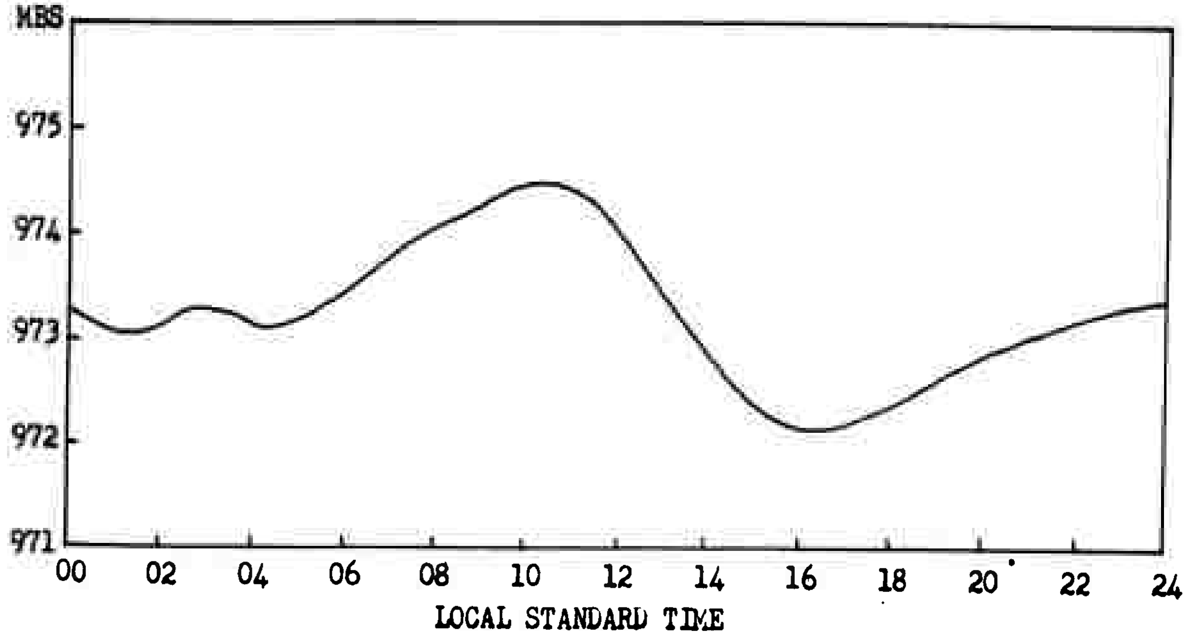
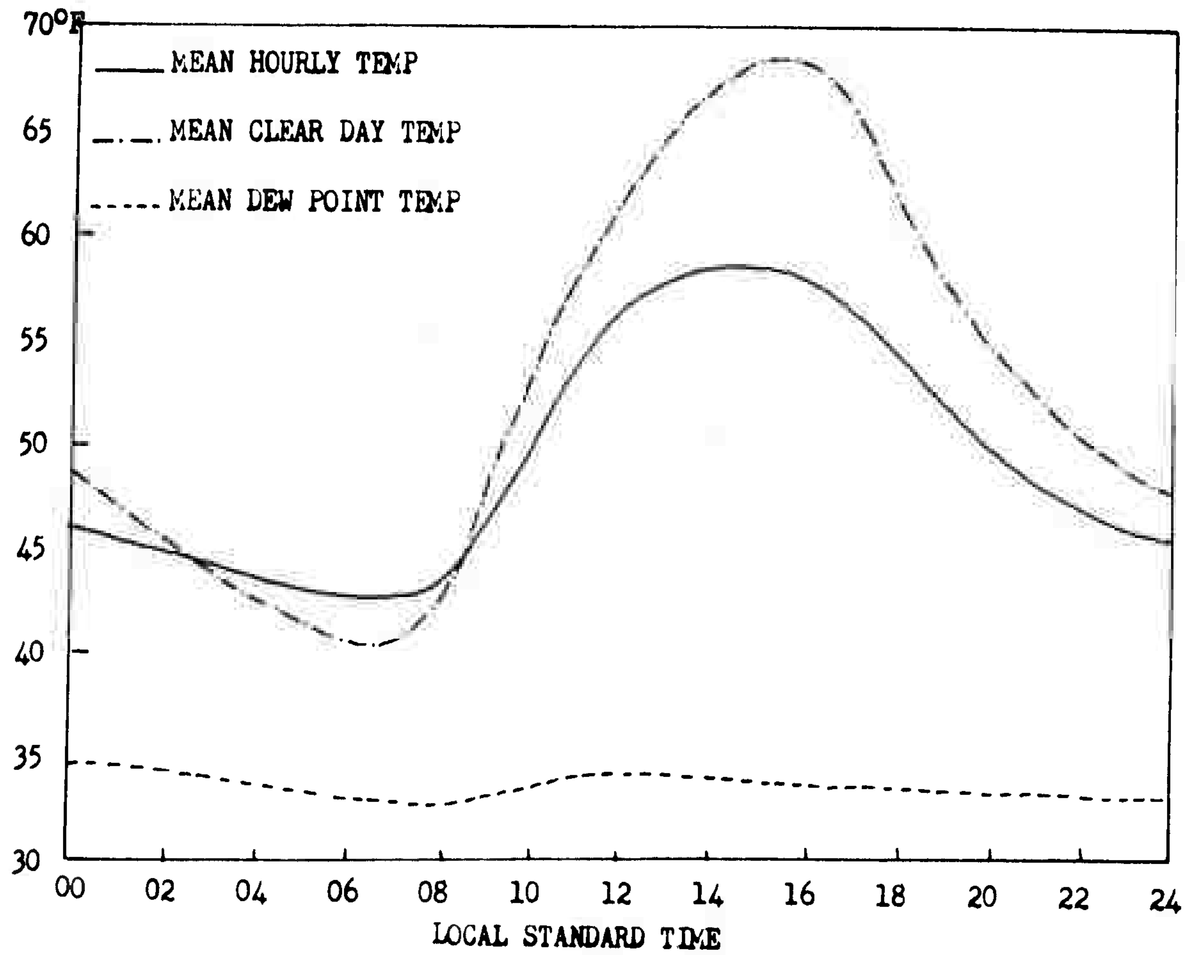


Figure 3-6u. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940)."

NOVEMBER

Figure 3-6v. Mean Temperatures and dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other Temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep 1949-Aug 1959.



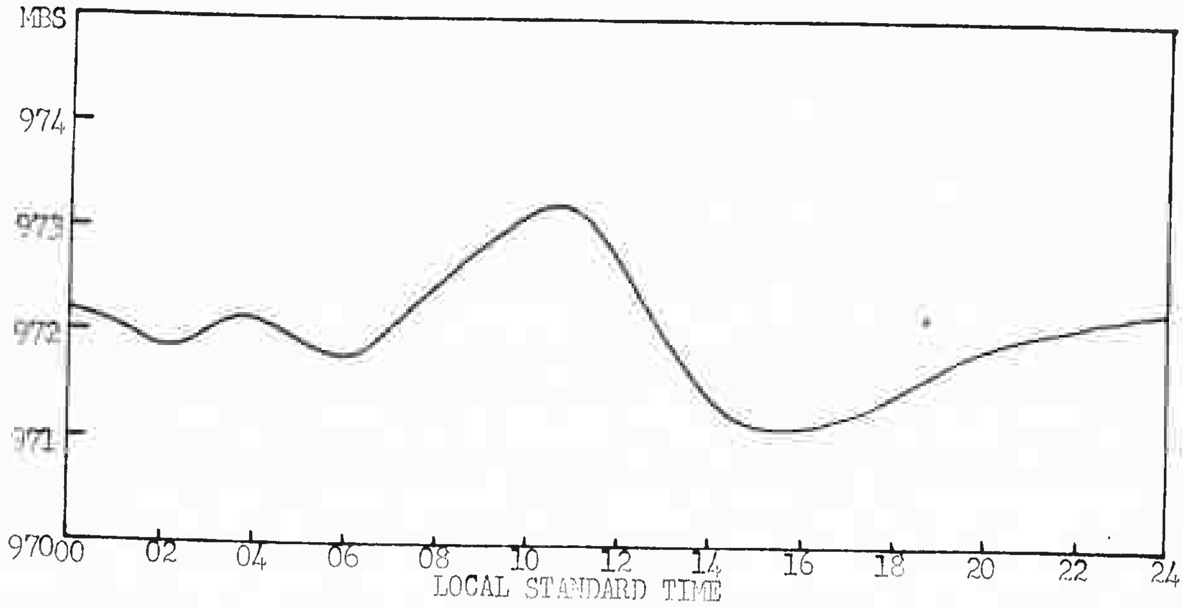
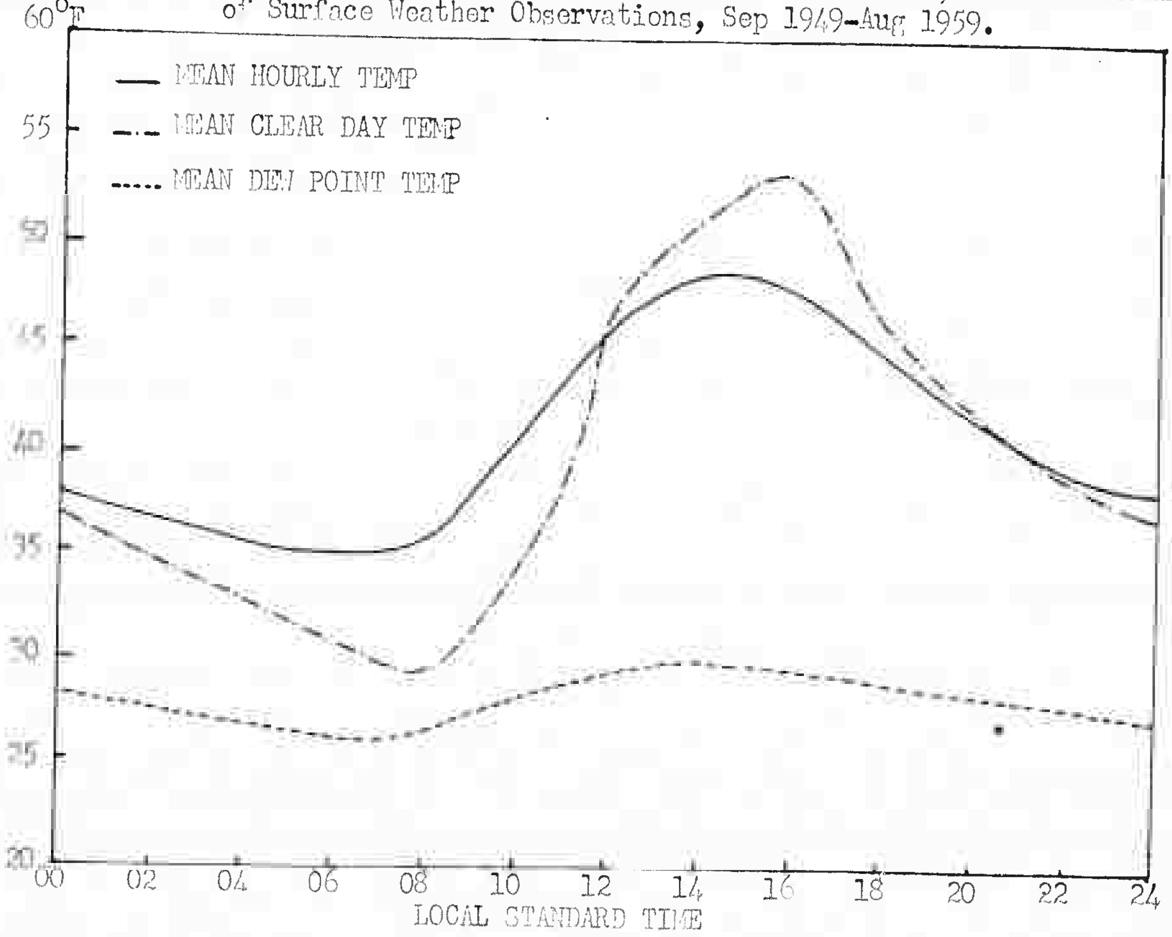
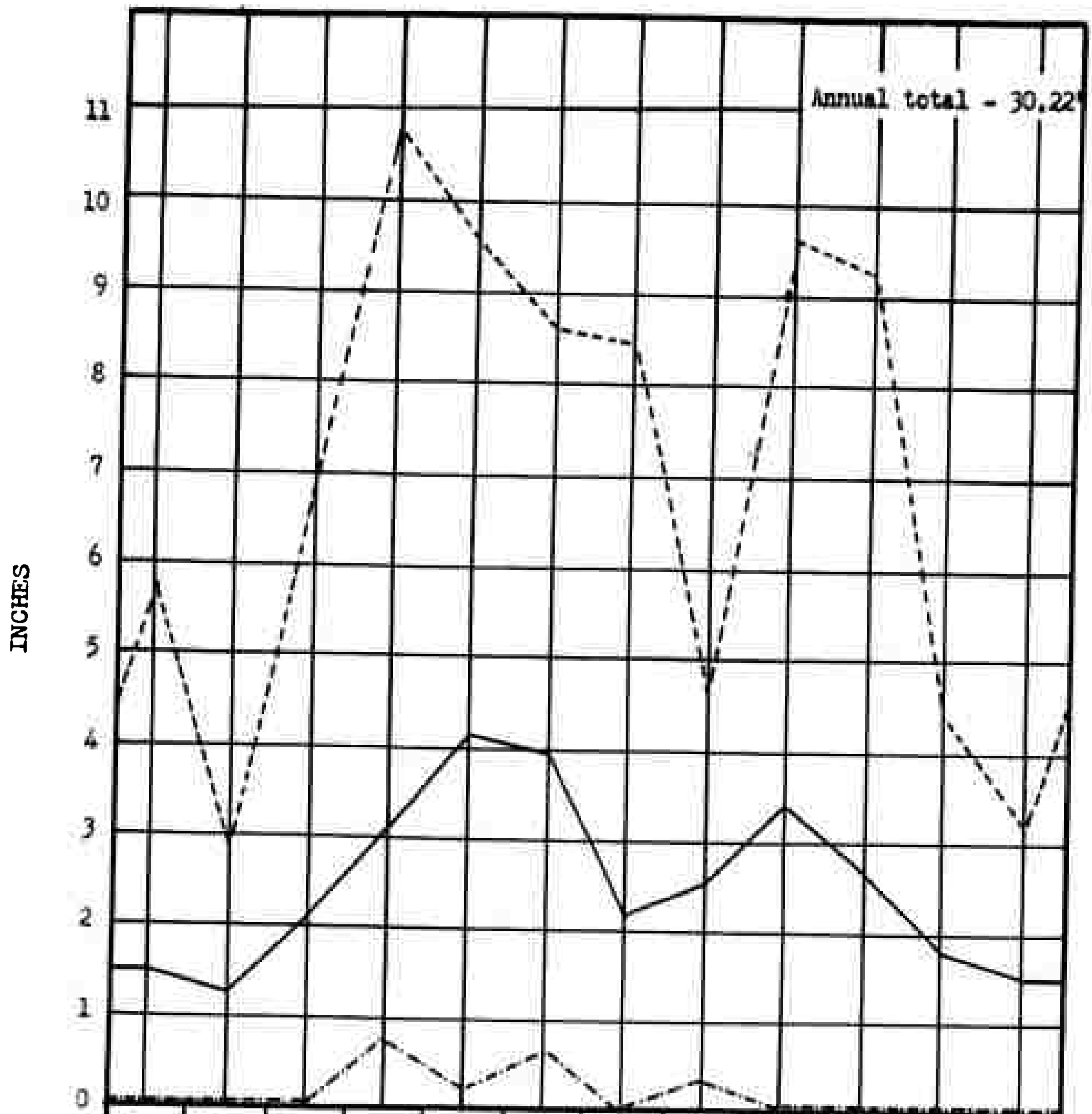


Figure 3-6w. Normal Station Pressure for Oklahoma City, Oklahoma from a Weather Bureau Summary "Normal Station Pressures (1931-1940)."

DECEMBER

Figure 3-6x. Mean Temperatures and dew point for Tinker AFB, Oklahoma. Clear day temperatures were extracted from Tinker AFB WBAN 10's for a 3 year period. Other temperatures from Part "E", Uniform Summary of Surface Weather Observations, Sep 1949-Aug 1959.





	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1. Max 24hr precip.	1.52	1.75	3.44	3.40	4.73	4.39	2.89	2.45	4.09	7.87	1.96	1.86
2. Avg. mo. snowfall	3.3	2.2	1.7	T	0	0	0	0	0	T	.3	1.3
3. Max. mo. snowfall	17.3	8.8	11.2	.7	0	0	0	0	0	T	2.6	7.0

Graph 2. Monthly maximum, mean, and minimum amounts of precipitation are indicated in the above curves. Data represented in the graph and in the table are from the Uniform Summary of Surface Weather Observations (for TAFB) for the period December 1942 to January 1946, and September 1946 to September 1953 and from USWB records (for Oklahoma City) for the period 1921 to 1959.

Legend:

-----Maximum monthly precip

____Mean monthly precip

_._._.Minimum monthly precip

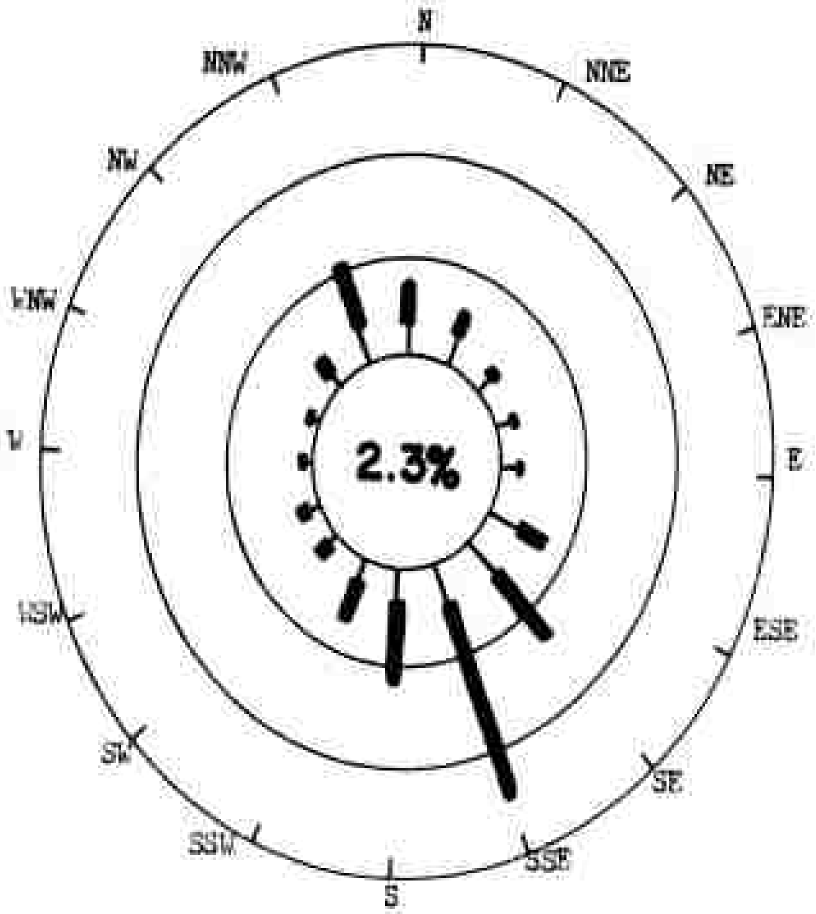
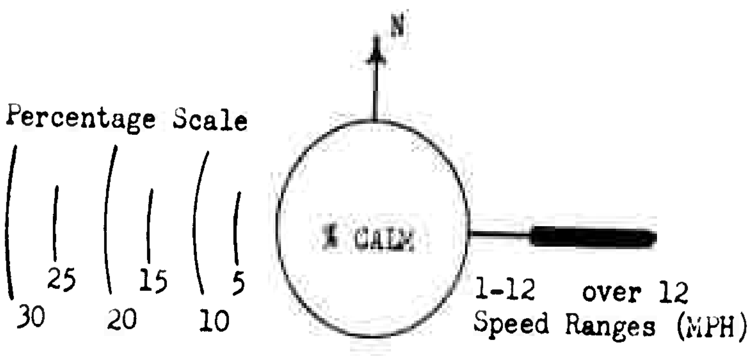


Figure 3-7. Annual Surface Wind Rose. Period of record: Dec 1942-Jan 1956, and Sep 1946-Sep 1953.



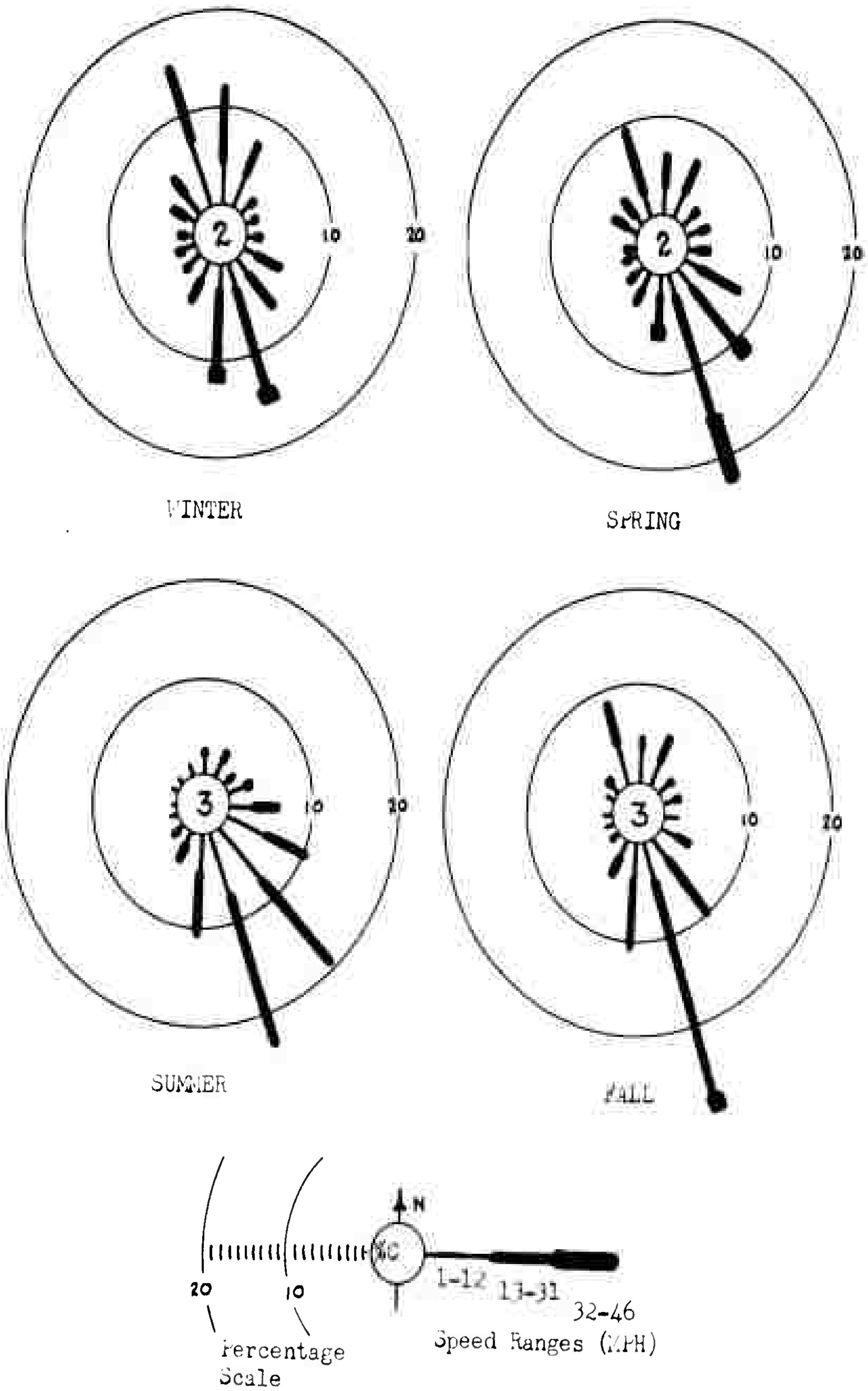


Figure 3-7b. Seasonal Surface Wind Roses. Period of Record: Dec 1942-Jan 1946, and Sep 1946-Sep 1953. Tinker AFB, Oklahoma City, Oklahoma.

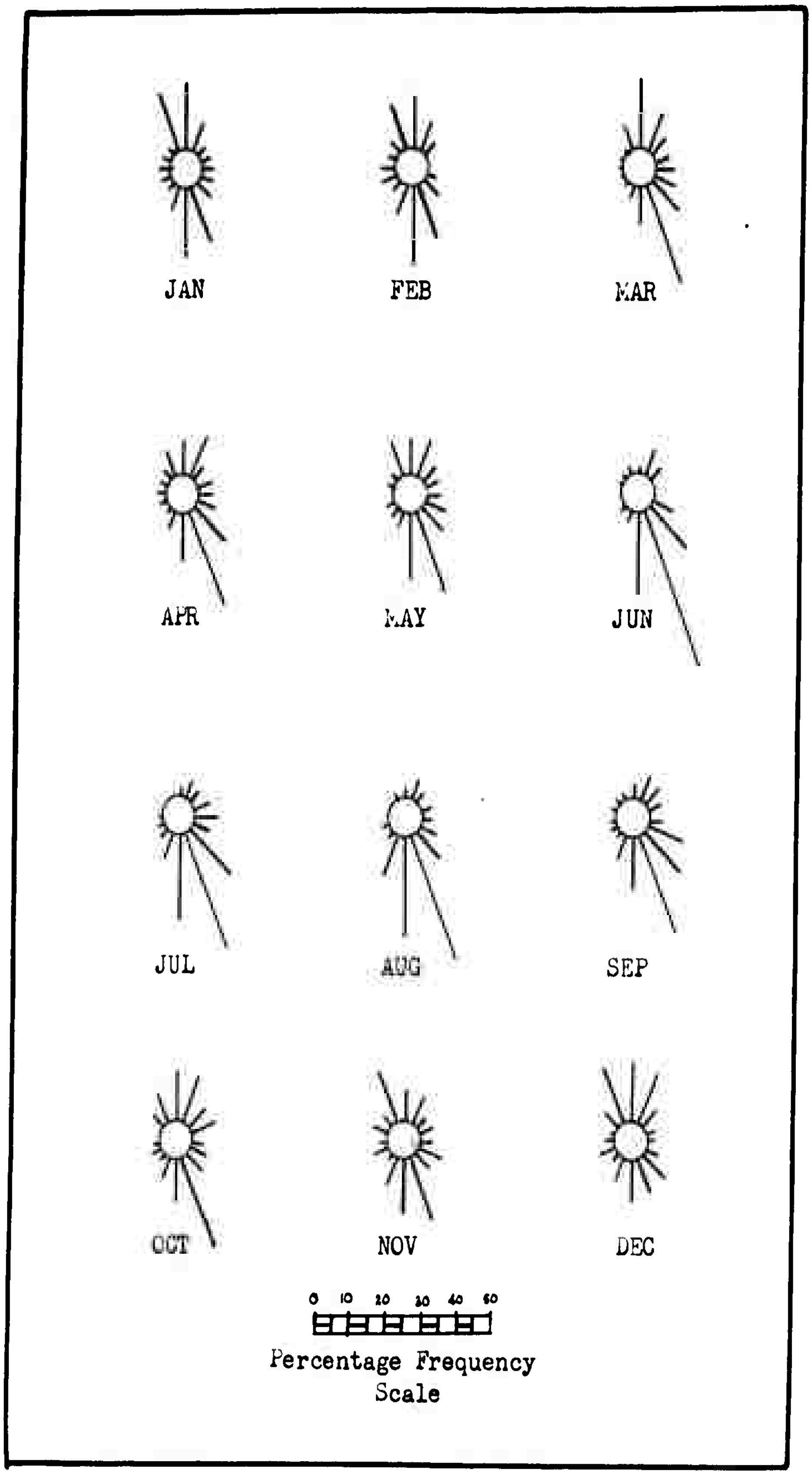
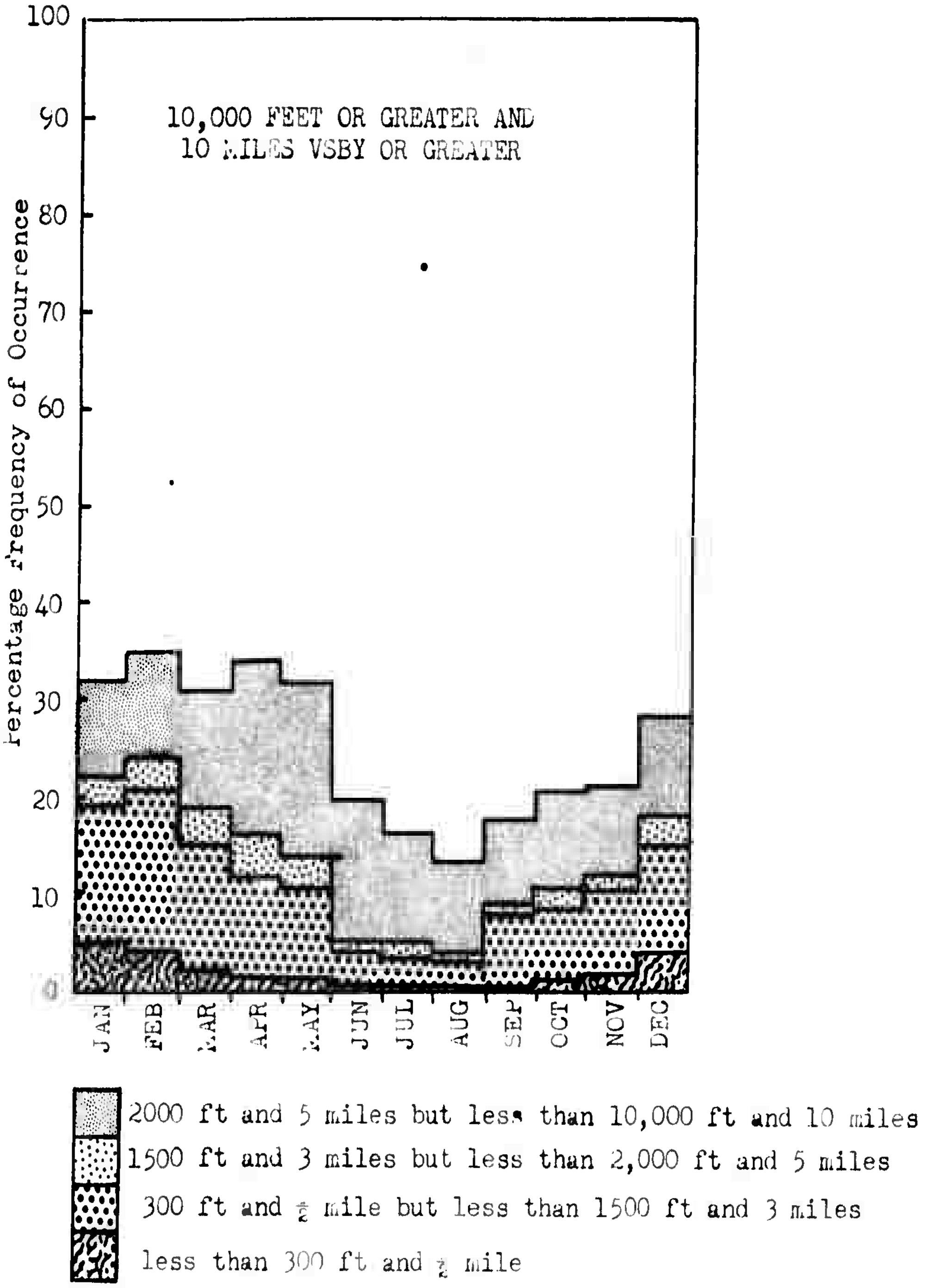
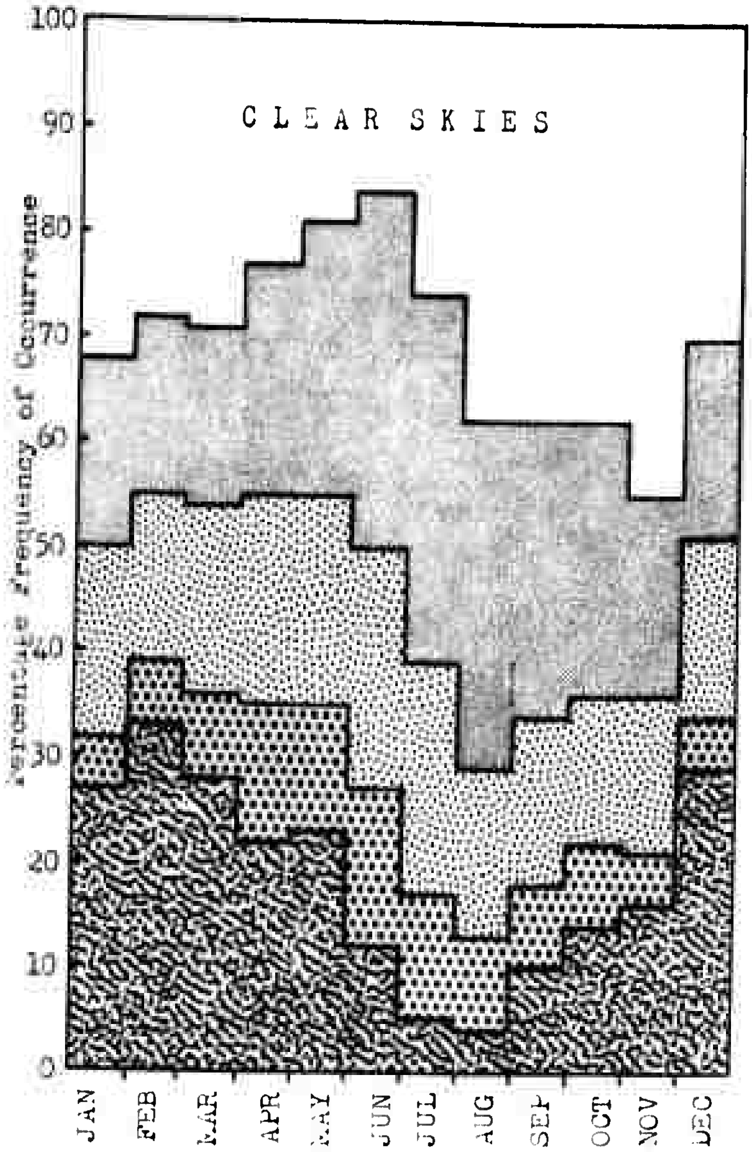


Figure 3-8. Monthly Wind Roses (5)



Graph 4. Frequency of occurrence of ceiling versus visibility by the month at Tinker AFB, Oklahoma. Data from Part "D", Uniform Summary of Surface Weather Observations for the period Nov 1945-Jan 1946, and Sep 1946-May 1956.



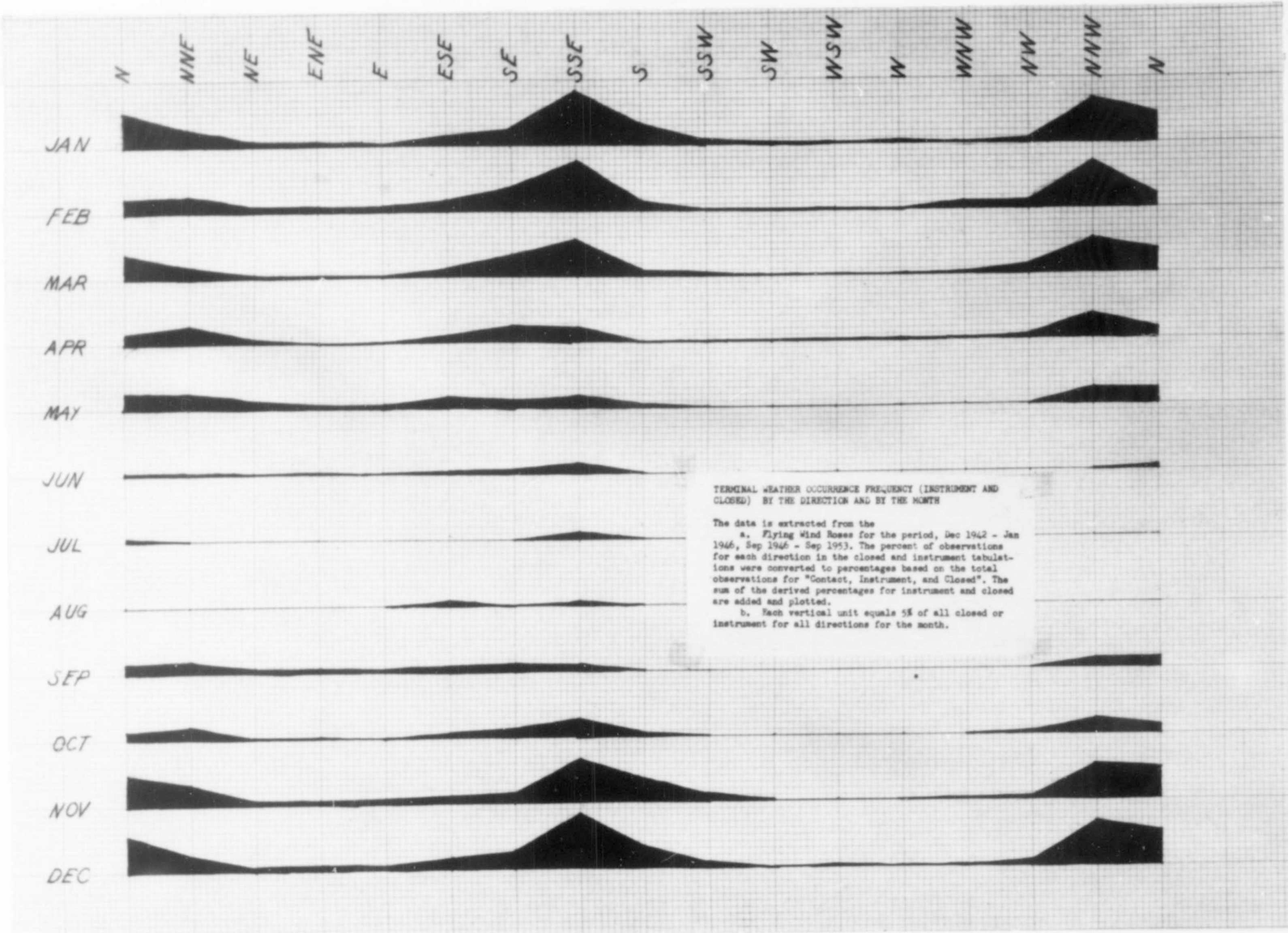
Scattered clouds

High broken or overcast with sctd or no low clouds

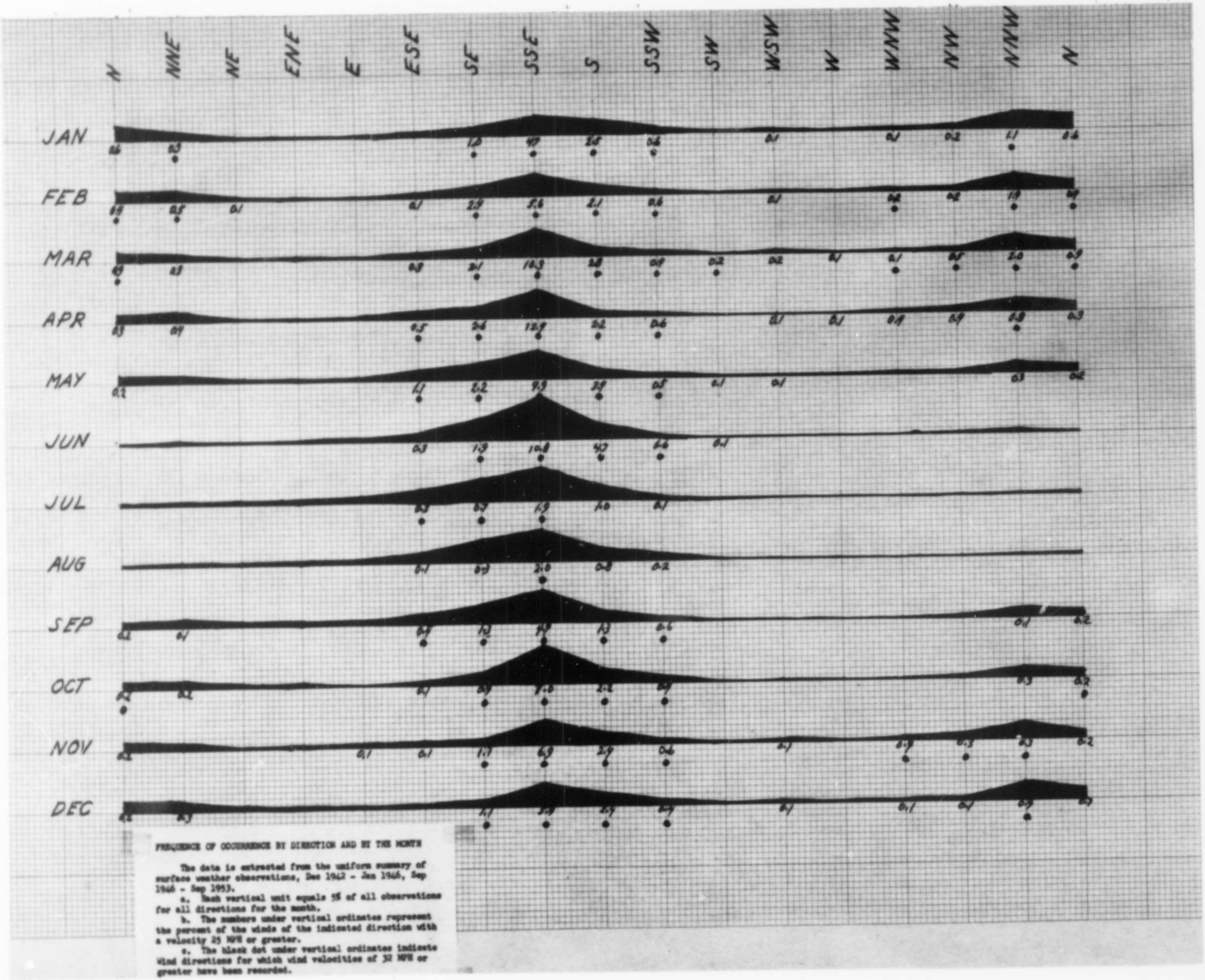
Low broken clouds (10,000 feet or under)

Low overcast clouds (10,000 feet or under)

Graph 5. Frequency of occurrence of the various sky conditions for Tinker AFB, Oklahoma. Data from Uniform Summary of Surface Weather Observations for the period December 1942- January 1946, and September 1946-September 1953.



Graph 6. Terminal Weather Occurrence Frequency (IFR and Below GCA Minimums) by the direction and by the month. Data extracted from "Flying Weather Wind Roses" for Tinker AFB, Oklahoma for the period Dec 1942-Jan 1946 and Sep 1946-Sep 1953.



Graph 7. Frequency of Occurrence of Surface Wind Directions at Tinker AFB, Oklahoma.

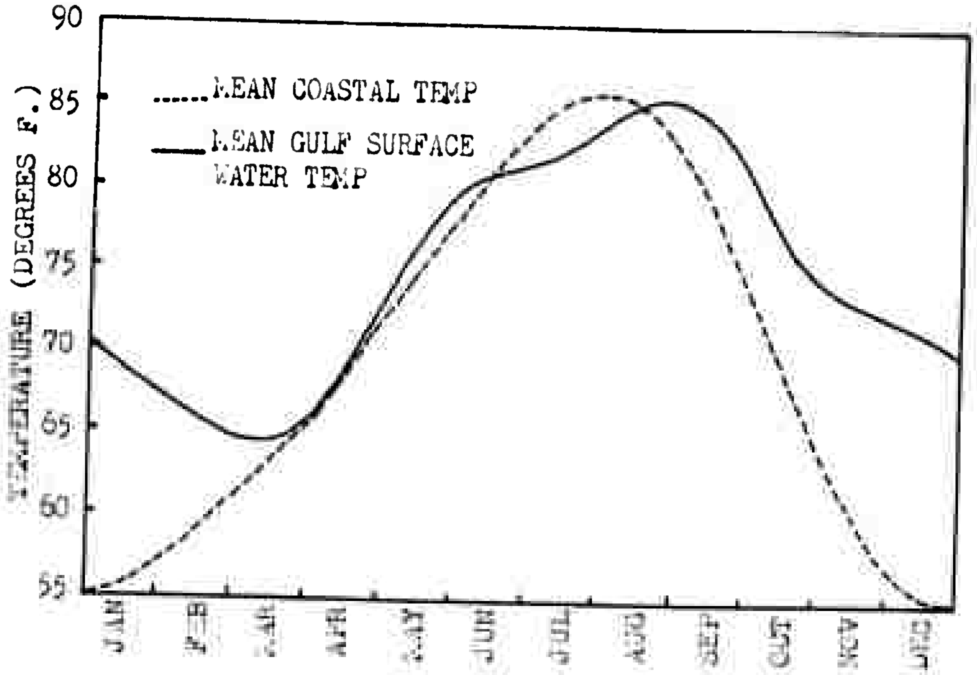
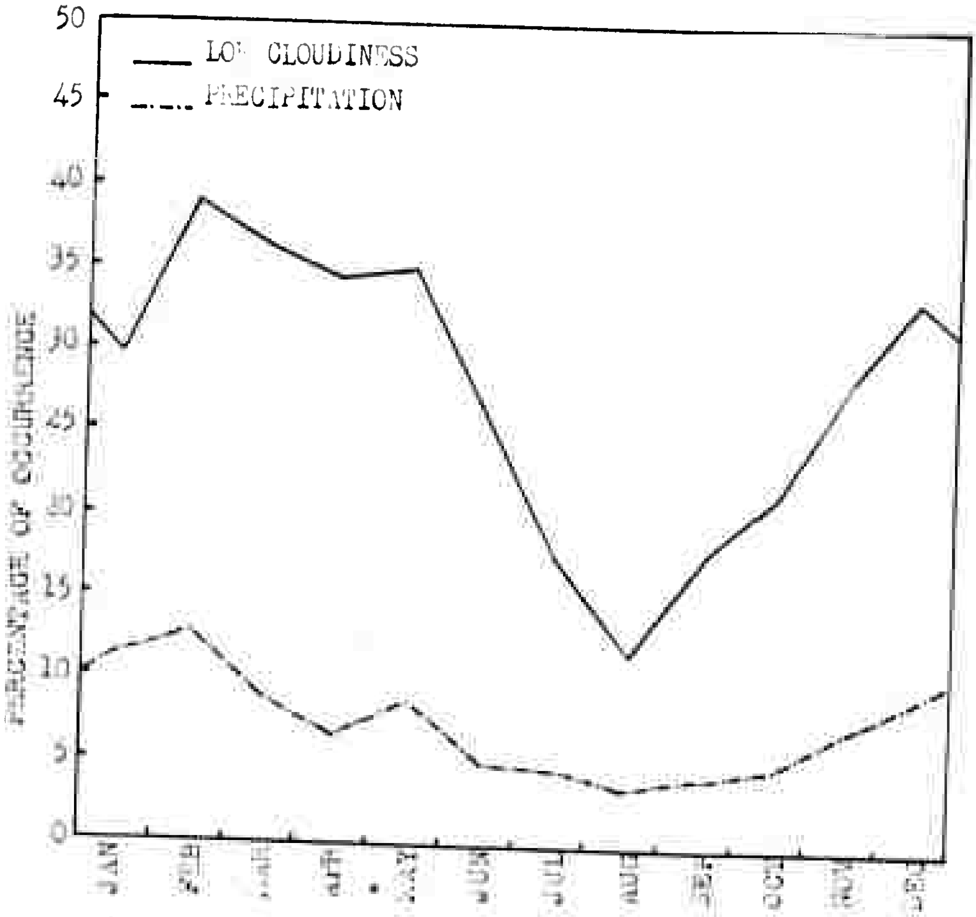


Figure 3-9 These graphs correlate the mean monthly difference between the Gulf of Mexico surface water temperature, the surface temperature along the coast, the mean monthly cloudiness at Tinker AFB, and the occurrence of precipitation at Tinker. Water temperatures are from the "Temperature of the Surface Waters of the Atlantic Ocean", Vol VI, No 1, March 1943.



The coast temperatures are taken from the USWB charts "Average Daily Temperature" for each month.
Tinker data is from the "Uniform Summary of Surface Observations" based on eleven years data.

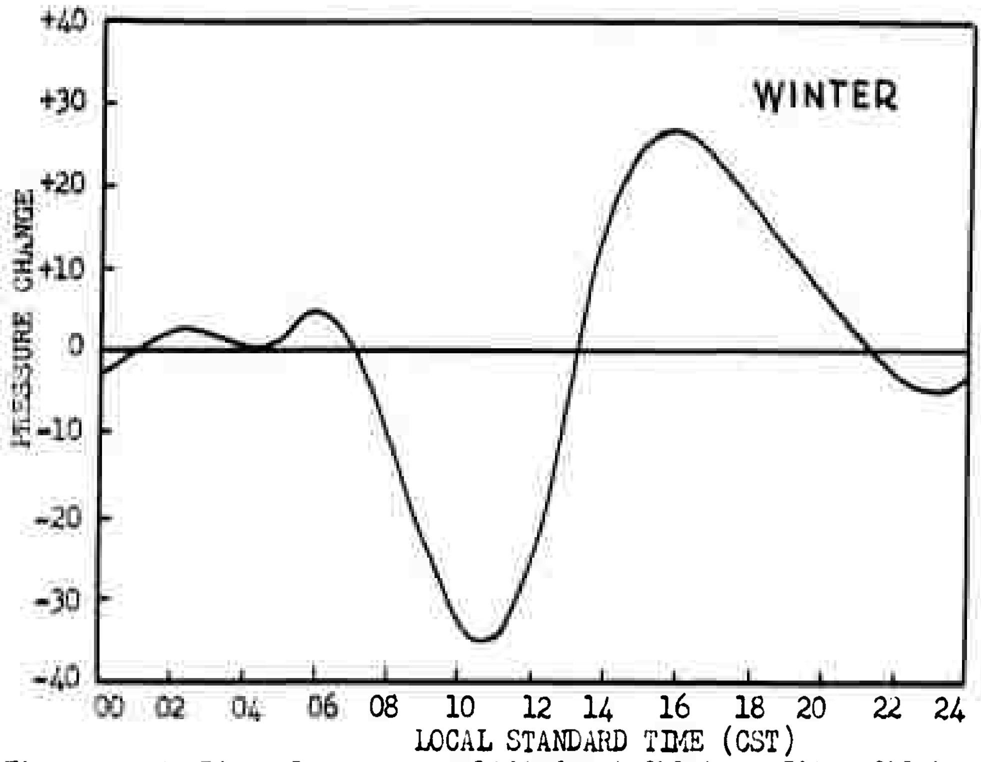


Figure 3-10. Diurnal pressure altitude at Oklahoma City, Oklahoma for the months of November, December, and January. From USWB Technical Paper No. 1 - Normal Pressures and Tendencies for the United States.

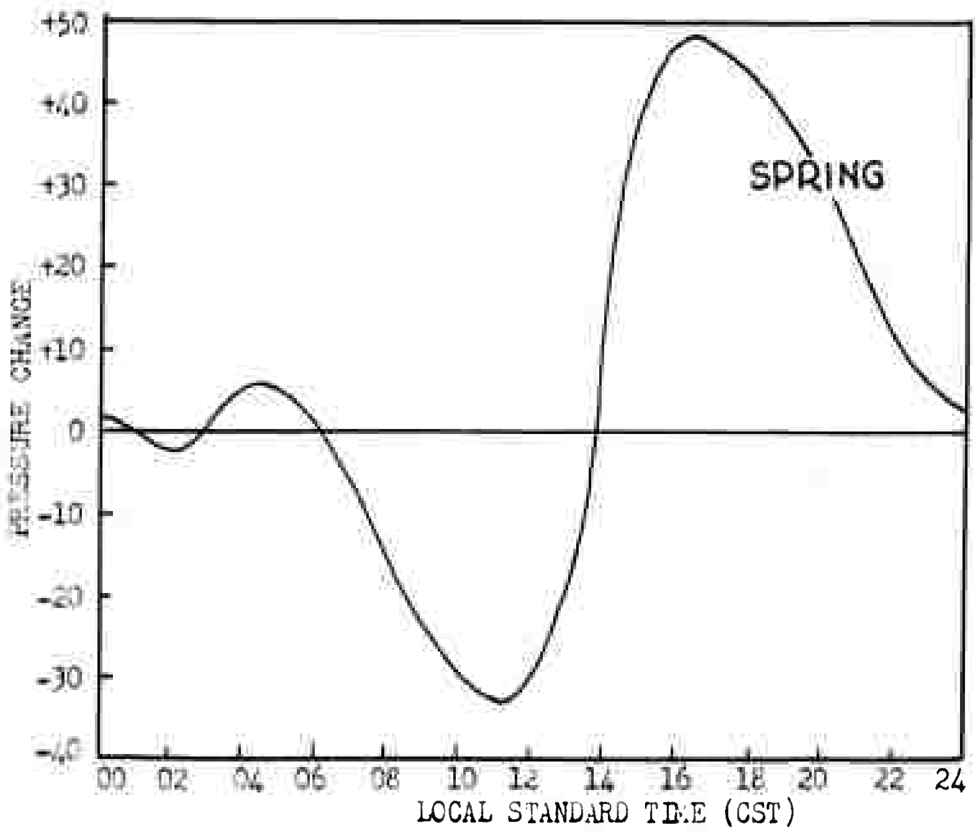


Figure 3-11. Diurnal pressure altitude for Oklahoma City, Oklahoma for the months of February, March, and April. From USWB Technical Paper No. 1 - Normal Pressures and Tendencies for the United States.

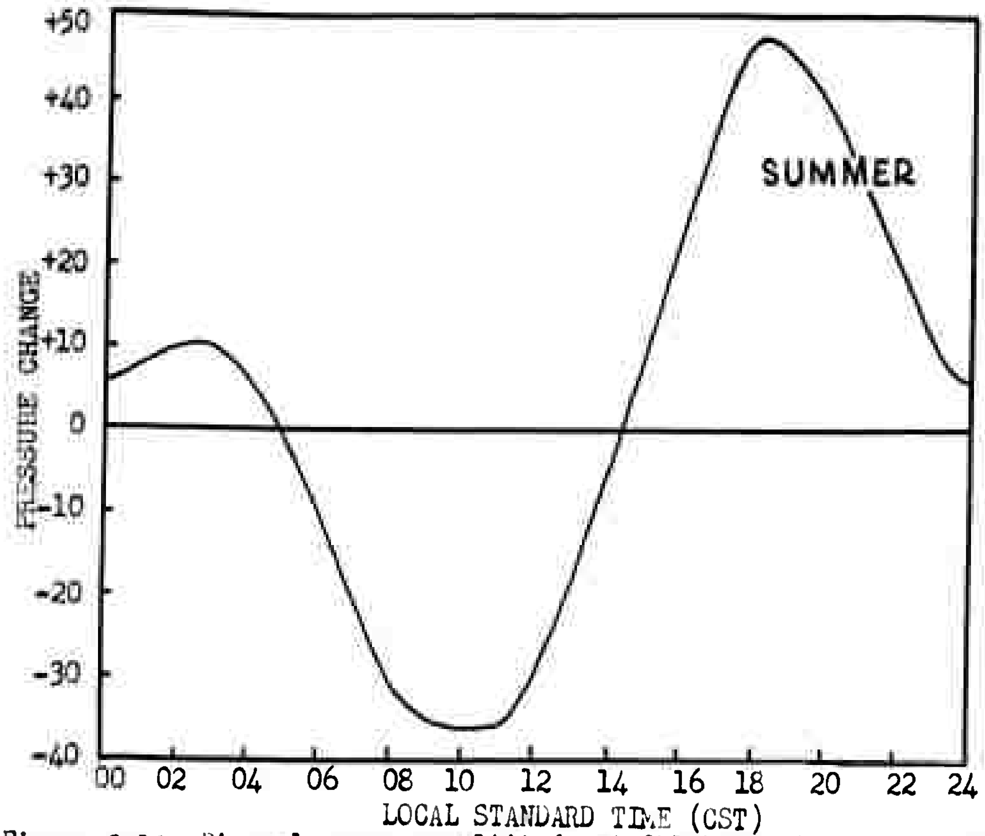


Figure 3-12. Diurnal pressure altitude at Oklahoma City, Oklahoma for the months of May, June, and July. From USWB Technical Paper No. 1 - Normal Pressures and Tendencies for the United States.

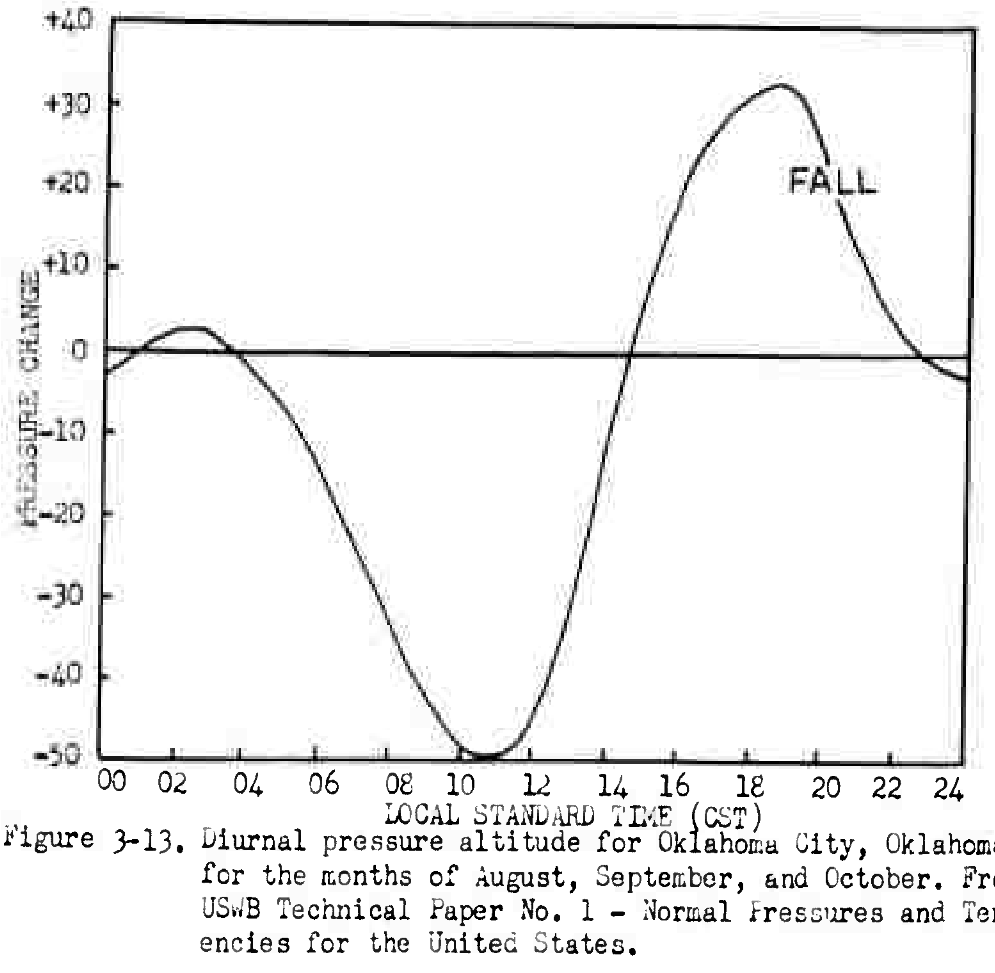


Figure 3-13. Diurnal pressure altitude for Oklahoma City, Oklahoma for the months of August, September, and October. From USWB Technical Paper No. 1 - Normal Pressures and Tendencies for the United States.

SECTION IV

LOCAL FORECAST STUDIES

TINKER AIR FORCE BASE, OKLAHOMA

LOCAL FORECAST STUDIES

OBJECTIVE STUDIES

TINKER AIR FORCE BASE, OKLA

LOW LEVEL WIND STREAMS

TINKER AFB, OKLAHOMA

L/COL HARRY N. MONFORT

MARCH 1959

1. Low Level Wind Streams

From the investigation of the Low Level Jet undertaken at this detachment the following important considerations relative to this phenomena evolved:

a. A better understanding of the low level wind field and the diurnal variations resulting from radiational heating and cooling has been obtained and this will serve to reveal the best parameters for surface wind objective forecasting techniques.

b. The hazards existing to landing large cargo type aircraft and more especially modern high-wing-loading jet aircraft through the unusually strong wind shears such as often exist at Tinker from midnight to sunrise must be understood by our forecasters and operations personnel.

c. The importance of this low level jet in the advection of low level instability and moisture during the severe weather season at Tinker is obvious. A study of thunderstorms and precipitation patterns during periods when the low level jet is favored indicates a significant difference in the intensity observed at night as opposed to those that develop in the afternoon and early evening.

More recent studies show that the low level jet phenomena occurs almost everywhere over the United States in clear weather during nighttime hours. However, the strongest and most frequent low level jet stream occurs in the Great Plains. Rather than looking like a river (as the high level jet appears) it is as if a sheet of rapidly moving air were sandwiched between slow moving layers of air, above and below (6).

How The Low Level Jet Forms

During the daytime, thermals rise above the heated ground and cause considerable mixing between the surface and upper layers (up to a height of approximately 7000 feet). Air going up is replaced by descending air parcels from higher levels which bring higher speeds with them. This additional momentum is imparted to the air in the surface layer, and the low level wind increases until the momentum from above is matched by the loss at the ground, which is produced by frictional drag. When this occurs, aircraft tend to float during mid-day landings. The gain in wind speed by the surface layers (surface to 300 feet) is equal to the loss by the upper layers minus the energy lost due to eddy viscosity (6).

At night, convestion ceases, and with it the exchange of momentum between the lower and upper layers. Deprived of additional mementum, and exposed to the frictional drag of the ground, the surface wind slows down. At the same time, the upper layer air is freed of its restraint (due to convection), and begins to speed up under the combined influence of the horizontal pressure gradient and the rotation of the earth. As a result, a maximum is reached near midnight at about 3500 feet (MSL).

How to Forecast the Low Level Jet

The low level jet varies through a precise cycle, often for several days in sequence. During the sunshine or heating period of the day when conditions favor the momentum exchange necessary (see above), the wind speed gradient is very weak and constant from the surface to about 7000 feet; but during the night this pattern is radically changed.

The attached charts are mean isotach analyses for the three seasons that we may most often expect the low level jet in this area: Jan-Mar, Apr-Jun, and Jul-Sep. They were prepared from Oklahoma City and Tinker wind data and should be representative over the entire state of Oklahoma. They show the mean wind speed variations by the hour through the atmosphere from the surface up to 10,000 feet. They reflect the diurnal wind speed variations since they were prepared by averaging all observed wind speeds by the month, through 1958. Our investigations of this phenomena at Tinker over the past six years reveals that the conditions favoring the formation occur approximately 60 percent of the nights during late Spring through Summer to about mid-Fall. Therefore,because the charts are mean charts including data for the other 40 percent of the wind patterns, the isotach values indicated on the charts should be approximately increased to give more realistic wind speeds for the occastions when low level wind streams actually develop. It has been determined that the most representative figure for <u>the strength of the low level jet is obtained by doubling the isotach values</u> indicated on the seasonal charts.

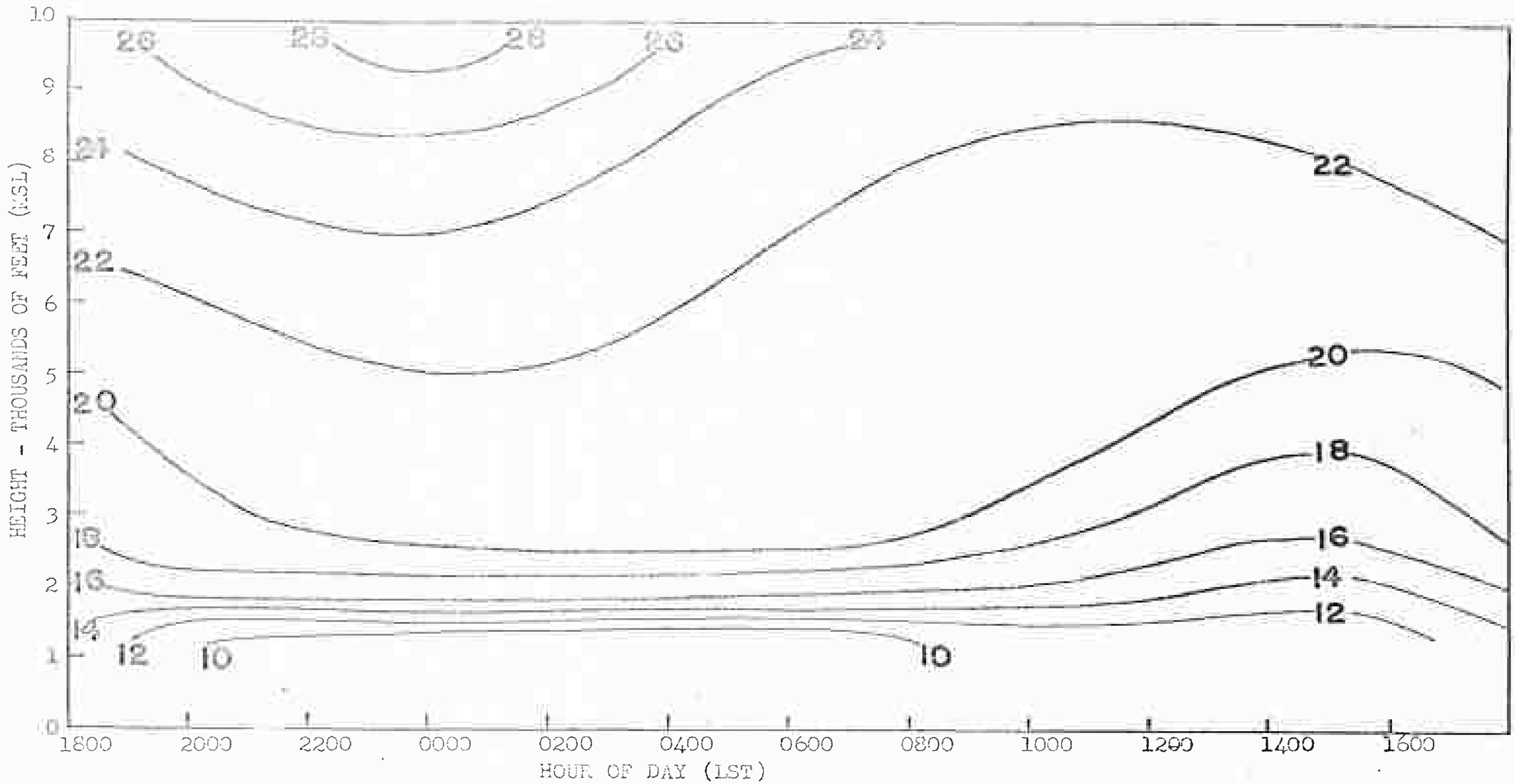


Figure 4-1. Mean wind velocities for Tinker AFB, Oklahoma for January, February, and March.

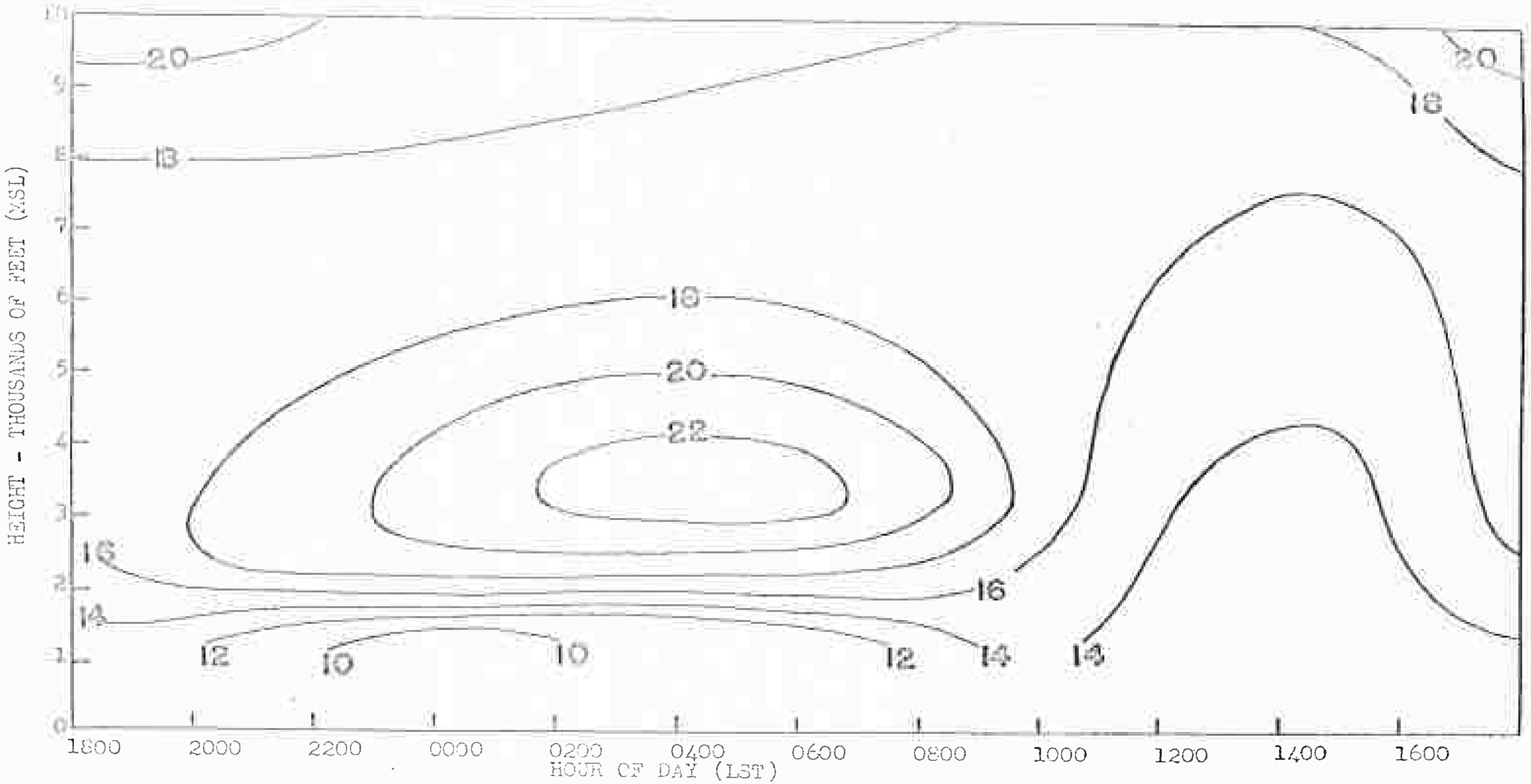


Figure 4-2. Mean wind velocities for Tinker AFB, Oklahoma for April, May, and June.

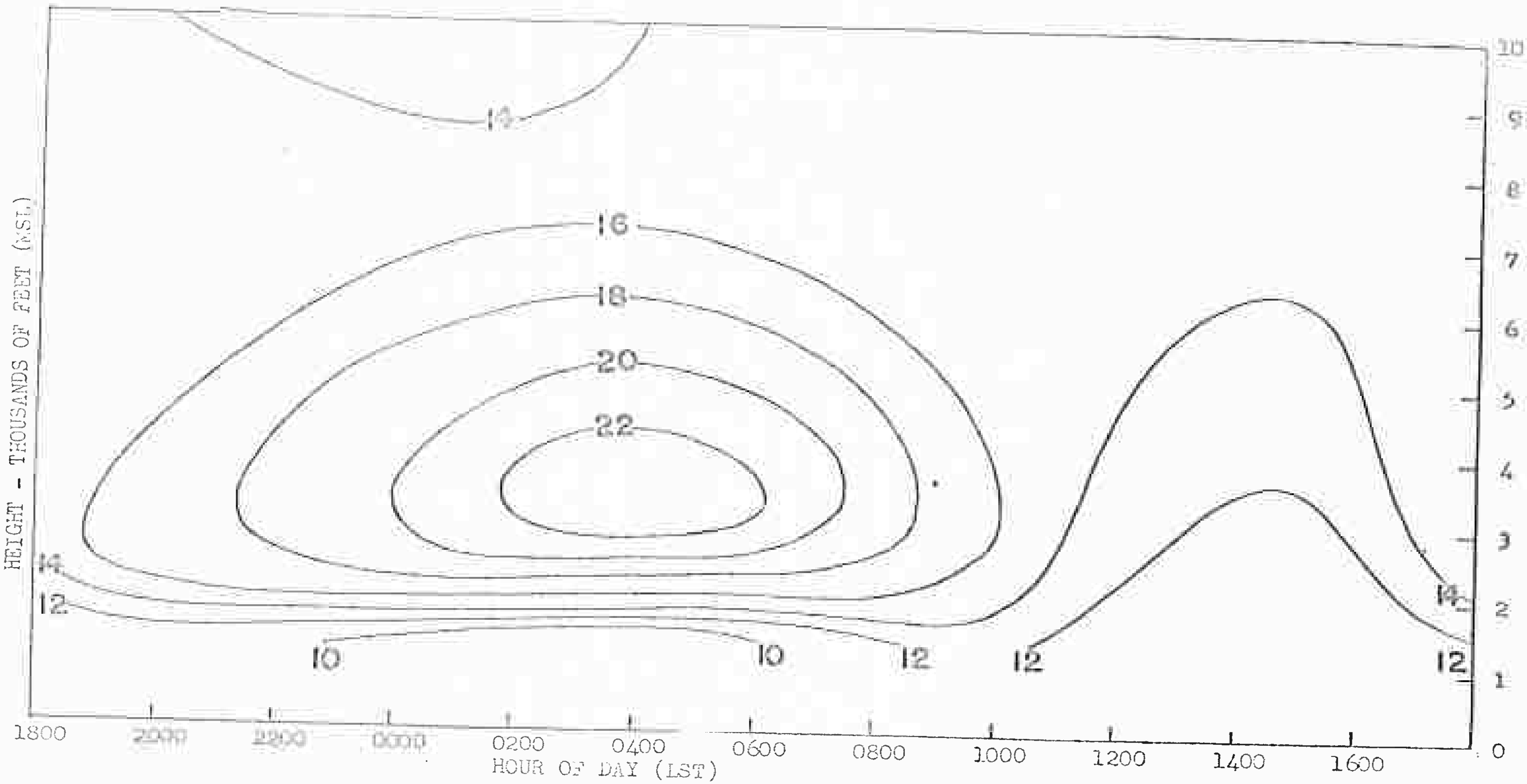


Figure 4-3. Mean wind velocities for Tinker AFB, Oklahoma for July, August, and September.

STRATUS STUDY

TINKER AFB, OKLAHOMA

L/COL HARRY N. MONFORT

OCTOBER 1956

TINKER STRATUS STUDY

CLIMATIC ASPECTS:

A review of the Tinker "Uniform Summary of Surface Observations" shows the probability of ceilings occurring 2000 feet or lower ranges from a maximum in February of 26% to a minimum in August of 4%. The causes of these low ceilings in decreasing rank of importance are as follows:

a. Over-running: Over-running is defined as a situation in which a humid air mass is lifted by the wind flow over a relatively dry air mass at the surface, e.g. a maritime air mass over a continental polar air mass. Specifically, cases in which the air at the surface has not had a trajectory over the Gulf while the flow aloft has come over the Gulf of Mexico at low levels (surface to 8,000 feet), or from the Pacific at high levels (8,000 to 15,000 feet). Stratus associated with frontal passages would be included in this category.

b. Gulf Stratus: Gulf stratus over Tinker develops from an air mass which from the surface to about the gradient level has had a trajectory over the Gulf of Mexico. The stratus is produced by a combination of upslope, convergence, and nocturnal cooling processes. It occurs less often than over-running, but is most frequent from about 15 April to 15 June.

c. Strato-cumulus: This is a third category of ceilings 2,000 feet or lower which is produced by the evaporation of moisture from the surface into the invading continental polar air mass during the fall through winter and spring seasons. The strato-cumulus type ceilings frequently follow over-running activity.

A preliminary gross survey of the stratus subject was performed by forecasters of this station with a detailed analysis of all occurrences between 31 August 1955 and 30 June 1956. The data were tabulated according to type, time of onset, ending, and duration. The data were summarized into tables, included as attachment "A" to this study. Conclusions from these may be briefly stated as follows:

a. During the period studied, ceilings 2000 feet or lower occurred on 104 out of 300 days or in a ratio of 1 out of 3 days.

b. Sixty of the low ceilings periods started during the night time as opposed to an occurrence of only 13 starting during the day.

c. The duration of over-running periods ranges without a pattern from one-half to 132 hours.

d. Gulf stratus occurred one half as often as over-running (in this study) 30 and 70 cases respectively.

e. The duration of Gulf stratus ranges from one-half to 58.5 hours.

f. Gulf stratus occurs most often in the months of April, May, and June. The appears to be a diurnal pattern in the beginning and duration of the occurrences in these months.

Forecasting Low Ceilings

Considerable time and effort has been expended by forecasters of this station on devising both objective and subjective methods of forecasting low ceilings at Tinker. Some of the predictors tried without significant success are as follows:

a. The 1500Z 850MB wind dd at Tinker versus Tinker 1830C surface dewpoint minus 1500Z 850MB dewpoint.

b. The Fort Worth 1500Z 850MB wind dd versus Fort Worth dewpoint spread at 850MB.

c. The Fort Worth wind dd (1830C surface) versus Fort Worth dewpoint spread.

d. The Tinker 1830C surface dew-point spread versus 1500C 850MB wind dd minus surface 1830C wind dd.

e. Tinker surface wind dd versus Tinker dew-point spread.

f. Tinker wind direction factor versus Tinker moisture factors for 1830C and 0630C. (In this study the wind factor is a mean wind vector and the moisture factor is the sum of the dew-point spread and the 12 hour temperature change)

Experimentation with a subjective method was also carried out during the above mentioned survey. This method has worked quite well in several cases and is retained as attachment "B" to this study.

STRATUS STATISTICS FOR TINKER AFB, OKLA. 31 AUG 1955-30 JUN 1956

	Total Hours Over-running	Total Hours Gulf Stratus*	Number of Occurrences Over-Running	Gulf Stratus	Days of Occurrence
Sep 55	131.9	18.0	4	1	9
Oct 55	3.0	29.0	2	4	6
Nov 55	16.5	5.5	3	2	6
Dec 55	46.0	44.5	6	4	11
Jan 56	162.5	58.5	8	1	14
Feb 56	234.0	39.5	9	1	16
Mar 56	106.5	24.5	4	2	9
Apr 56	157.5	28.0	5	3	13
Mar 56	65.0	14.0	3	6	14
Jun 56	0	45.0	0	6	6

	Total Over-running and Gulf Stratus Occurrences Night	Day**	Total Over-running and Gulf Stratus Began Night	Day	Gulf Stratus Began Night	Day	Over-running Began Night	Day
Sep 55	9	6	4	1	1	0	3	1
Oct 55	6	3	4	2	2	2	2	0
Nov 55	4	2	4	1	1	1	3	0
Dec 55	9	9	8	1	3	0	5	1
Jan 56	11	12	6	3	1	0	5	3
Feb 56	15	15	8	1	1	0	8	1
Mar 56	9	8	5	1	2	0	3	1
Apr 56	9	7	8	0	3	0	5	0
May 56	10	8	8	2	5	1	3	0
Jun 56	6	5	5	1	6	1	0	0

*The Gulf stratus classifications were definitely established by a study of surface analyses and winds aloft data. All remaining cases were classed as over-running. Therefore, the later classification includes the pure strato-cumulus cases also.

**Night is considered as occurring between the hours of 1830C through 0830C. Day is from 0830C through 1830C.

STRATUS FORECASTING FOR TIK DURING
THE MONTHS NOVEMBER THROUGH MARCH

This forecast technique is based on the assumption that the Gulf of Mexico is the moisture source for stratus formation over Tinker. The stratus formation is based on two processes:

1. Advection of moisture from the Gulf.

2. Lifting of the airmass as it moves toward Tinker. This is a combination of orographic and isentropic lifting.

The stratus forecast is made from data collected at 1800C, and the predictors give the time following 1800C that ceilings 2000 feet or lower will form over Tinker.

The Necessary computations are based on the following data:

1. TIK is 600 feet (equivalent to 2.5°F) higher than Fort Worth.

2. TIK 1800C temperature
   1800C surface wind, direction (dd) and force (ff).

3. FWH 0600C Td(surface dew-point)
   1800C Td
   1800C T (surface temperature)
   1800C 850MB wind, dd and ff.

To use this procedure the TIK 1800C wind direction must not have a westerly component and the Fort Worth 1800C 850MB wind direction must not have a northerly component. Both winds are resolved into their N-S components.

The moisture advection rate (MAR) is:

a. $$\frac{(\text{FWH 0600C Td} - \text{FWH 1800C Td})}{12} \text{ - degrees/hour}$$

The lifting rate (L.R.) is:

b. $$\frac{(\text{FWH 1800C T} - \text{TIK 1800C T} + 2.5^{\circ})\ V}{150^{*}} \text{ - degrees/hour}$$

*Note: 150 is the nautical miles distance between TIK and FWH. V is the algebraic sum of the N-S wind components. When TIK's 1800C wind direction is between 90 and 180 degrees, it is disregarded and V represents only the N-S component of Fort Worth's 1500C 850MB wind direction.

Adding formulae a and b (LR + MAR) gives the degrees per hour that the 1800C FWH condensation level lowers as the air mass approaches TIK.

The condensation level (CL) over Tinker at 1800C may be assumed to equal

c. FWH 1800C T-Td + (FWH 1800C T - TIK 1800C T) - 2.5°F

where the FWH T-TIK T = ZERO when the TIK 1800C surface wind has a southerly component.

The time required for the TIK ceiling to lower to 2000 ft (9°F)* =

$$\text{formula } \frac{CL-9^{\circ}}{LR + MAR}$$

* 9°F is equivalent to a lift of 2000 feet at the adiabatic cooling rate.

The above technique covers synoptic situations which include those with fronts to the south of TIK as well as those without fronts. In case of no fronts to the south, the above formula could be expressed as follows:

$$MAR = \frac{\text{TIK 0600C Td} - \text{TIK 1800C Td}}{12}$$

$$LR = \frac{V^{*}\ 2.5^{\circ}F}{150}$$

* V = South component of mean wind vector between the TIK 1800C surface wind and the TIK 1800C 850MB wind.

$$\text{Time elapse from 1800C} - \frac{\text{TIK 1800C T-Td-6.0}^{\circ}F}{MAR + LR}$$

Where 6° is the average dewpoint spread associated with the formation of low ceilings over Tinker.

STRATUS WORK SHEET

TIK Data

a. 1800C T ________

b. 1800C wind ________

FWH Data

c. 0600C Td ________

d. 1800C Td ________

e. 1800C T ________

f. 1800C 850 MB wind ________

STOP IF:

TIK wind has a westerly component or FWH wind has a northerly component.

$$MAR = \frac{d - c}{12} =$$

$$LR = \frac{(e - a - 2.5)V^{*}}{150} =$$

*V = North component (b) plus south component (f)

The elapsed time from 1800C when TIK will have a ceiling of at least 2000 feet (ceiling 2000 ft or lower) equals:

$$\frac{(e - d) + (e - a) - 9.0^{\circ}F}{MAR + LR} =$$

Verification:

Time stratus first observed: ________________

Height of Ceiling: ________________

FORECASTING STRATUS AND FOG AT

TINKER AFB, OKLAHOMA

(AN OBJECTIVE STUDY)

MSGT DONALD R HALL

JANUARY 1962

FORECASTING STRATUS AND FOG AT TINKER AFB, OKLAHOMA

Weather Event Selected: The occurrence of stratus with bases below 2000 feet and/or fog restricting visibilities to less than 3 miles.

Statement of the Problem: To forecast the occurrence and duration of stratus ceilings and fog at Tinker AFB, Oklahoma 12 to 15 hours in advance of onset.

Stratus clouds adversely affect "field conditions" at Tinker AFB to a greater extent than does any other single weather phenomena. Through the period 1 December through 31 March, climatological records indicate that "field conditions" will be IFR or Below GCA Minimums over 15% of the time as a result of stratus and/or fog. While these two phenomena sometimes occur together, stratus alone occurs about three times as often as does fog alone.

Although parameters favorable for the formation of stratus are well known, continuing efforts to formulate a good objective method for forecasting its occurrence have met with little success in the past. This pilot study is another attempt to develop such a method.

Predictors: Parameters selected as probable predictors in this study are:

a. Wind direction at the first standard level above the surface - or about 2,000 feet MSL.

b. Height of the top of the lowest inversion measured in the standard atmosphere.

Both of these predictors are extracted from the 1800C (0000Z) Oklahoma City sounding.

Analysis: After examination of one year's data, it may be stated that:

a. Use of the low level inversion against the first standard level wind is a valid method of forecasting occurrence/non-occurrence of stratus and fog at Tinker AFB for the period 1 October through 30 April, but is of little value during the period 1 May through 30 September.

b. Time of onset and dissipation (or improvement) remains the unresolved problem in stratus and fog forecasting. To date, this study has shed little light in the solution of this problem.

Upslope or Overrunning appear to be less effective in the formation of stratus than radiational or advective cooling in the layer just below the lowest inversion to the author. Radiation seems to be the most important single cause. This conlusion is supported by the much higher incidence of stratus during the winter months when the low level heat budget favors cooling.

It is a truism that stratus at Tinker is associated with low level wind directions in the east half of the compass (a great majority of the time), with southeast being the most favorable single direction. As a rule, these winds prevail from several hours to several days prior to the appearance of stratus at this station.

The undeniable cause-effect relationship of wind direction to occurrence of stratus in this area makes this a necessary parameter in any stratus study undertaken here. A low level inversion, like an easterly wind, is necessary to the formation of stratus also. A study of soundings show that the temperature curve on the Skew-T tends to invert at some level below 10,000 feet <u>before</u> low level winds become favorable for stratus formation. The inversion usually sharpens as it lowers and frequently assumes the typical "stratus inversion" configuration. The fact that the inversion always precedes the stratus makes it a most likely predictor.

__Evaluation__: Due to the scarcity of data available to the author, it was decided to use all of the data used in the original study in the evaluation of the system. A more representative evaluation will be performed during the winter season 1961/62.

	FORECAST		
OBSERVED	OCCURRENCE OF WEATHER EVENT	NON-OCCURRENCE OF WEATHER EVENT	TOTAL
OCCURRENCE	33	4	37
NON-OCCURRENCE	4	79	83
TOTAL	37	83	120

Skill Score: .85

TINKER AIR FORCE BASE FOG AND STRATUS STUDY

FORECAST CHECKLIST NO. 3

For the Period 1 December-31 March

Date________________

REQUIRED DATA

a. OKC 2,000 ft wind direction. . . . . . . .________________

STOP HERE IF THE WIND HAS A WESTERLY COMPONENT OF GREATER THAN 30 DEGREES WEST.

b. Height of the top of the lowest inversion above MSL. . . .________

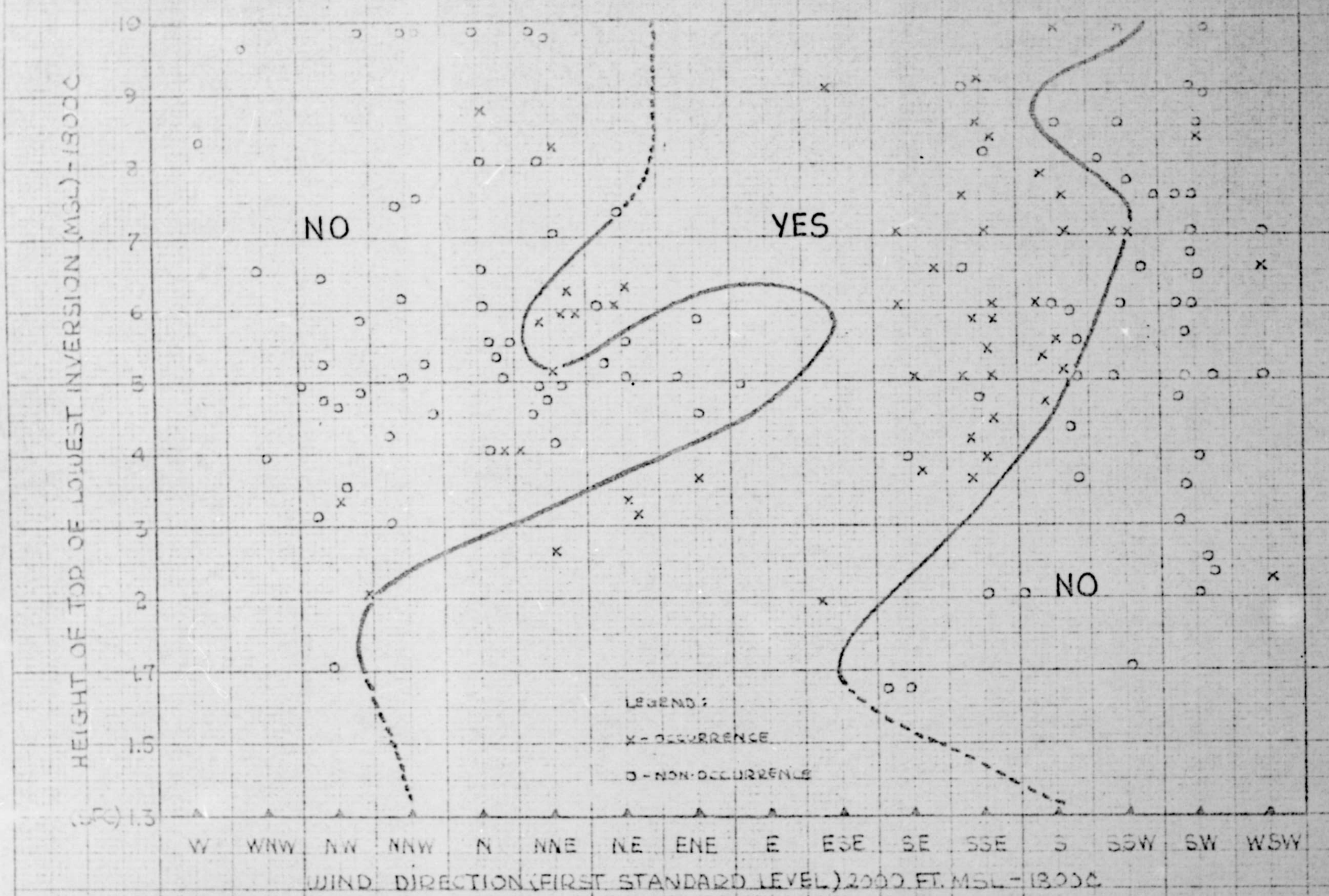
c. Enter Figure 1 with the above parameters.

VERIFICATION

a. Stratus (at or below 2,000 ft) or fog formed: YES_____ NO_____

b. Time of onset____________CST

c. Duration of phenomena:________________________________



HEIGHT OF TOP OF LOWEST INVERSION (MSL) - 1800C
10
9
8
7
6
5
4
3
2
1.7
1.5
(SFC) 1.3
NO
YES
NO
LEGEND:
X - OCCURRENCE
O - NON-OCCURRENCE
W
WNW
NW
NNW
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
WIND DIRECTION (FIRST STANDARD LEVEL) 2000 FT. MSL - 1800C

FIGURE 1.

FORECASTING CLEAR DAY SURFACE WINDS

AT TINKER AIR FORCE BASE

A SEMI-OBJECTIVE STUDY

REVISED JANUARY 1962

FORECASTING CLEAR DAY SURFACE WINDS AT TINKER AIR FORCE BASE

__The Forecast Problem:__ Surface winds 30 knots or greater are considered an operational hazard and local aircraft operations (ground and flying) require that they be forecast and warnings disseminated to specific base activities. For planning purposes it is desirable that a forecast for this phenomena be issued 6 or more hours in advance, and operationally it is required that a warning be disseminated at least 2 hours in advance of onset. Most of the critical wind velocities occur in the period from three hours after sunrise to about the time of the maximum temperature.

__Predictors:__ Parameters selected as probable predictors in this study are:

a. 850 MB wind velocity at 0000C-0600Z versus the peak surface gust velocity.

b. 850 MB wind velocity at 1200C-1800Z versus the peak surface gust velocity.

c. 850 MB wind velocity at 0000C-0600Z versus the surface wind velocity at 1500C-2100Z.

__Analysis:__ From the "Uniform Summary of Surface Observations" for this station it is determined that the months of March, April, May, and June are the months requiring the greatest concentration in regard to this forecast problem. It has been established from a perusal of surface weather observations for this station that the surface wind normally decreases during night time and increases during the daylight hours. Koppen and Espy independently explained the controlling mechanism in terms of diurnal variations of the temperature lapse rate in the lower atmosphere. Under stable conditions (such as exist during night time or low overcast day time conditions) the surface wind velocity is closely related to the surface pressure gradient whereas during the unstable lapse period which normally develops on a clear day, the control shifts to a higher level. Surface heating produces turbulent currents which serve to tie the lowest layers of air to the winds at approximately the 850MB level.

As a preliminary step in the original study, the diurnal variations at the surface and at 850MB were studied. It was determined from this study that on the average surface winds are at a minimum between the hours of 1830C and 2030C. It was further determined that the maximum surface velocity usually occurred at the time of maximum temperature. During the summer season conditions are more complex than in winter with secondary maximum and minimum velocities occurring at about 0900C and 0500C respectively. The seasonal characteristics of the wind at 850MB is available in the "Low Level Jet Stream" study for this station.

Correlation of Clear Day Surface Winds with 850MB Winds:

Several sets of parameters were tested in the original study to obtain correlations of 850MB winds and surface winds as a means of predicting maximum clear day velocity and peak gust velocity. The trials were generally unproductive, but are included as attachment #2 to this study to prevent duplication in future investigations.

Since efforts failed to produce a "pure" objective method using morning data to predict the maximum clear day wind velocity (except in special cases listed below), it was decided to devise a quasi-objective method using information described above. The scatter diagrams included with this study are self explanatory. They show that maximum clear day wind velocities can be fairly accurately predicted provided the 1200C 850MB wind velocity is accurately forecast.

CLEAR DAY SURFACE WIND FORECASTING PROCEDURE

General: This technique can be used to prepare the morning terminal forecast. This method is not valid for night time; cloudy days (days with middle or low clouds, broken or overcast); frontal passages; or cases when the surface wind direction is expected to be over 90 degrees out of phase with the 1200C 850MB wind direction.

This technique is valid when a clear day is forecast, i.e. when the surface heating is expected to be normal. Small departures from the normal of three or four degrees are usually to be expected due to warm or cold air advection. Such variations do not effect this forecasting method.

Procedure:

Step 1: Forecast the sky condition for the day and if the diurnal heating expected is near normal, proceed to Step 2.

Step 2: Forecast the 1200C 850MB wind velocity (See the "Low Level Jet Stream" study for diurnal variations). Using the 0600Z 850MB wind, estimate whether it will increase, decrease, or remain constant. If no significant change is expected, forecast the 1200C (1800Z) 850MB wind ff to equal 75% of the 0000C (0600Z) wind. If significant differences are expected, adjust for the diurnal variation and then increase or decrease the velocity as appropriate.

Step 3: Using the forecasted 1200C 850MB wind FF enter the table and read the forecasted surface velocity and peak gust.

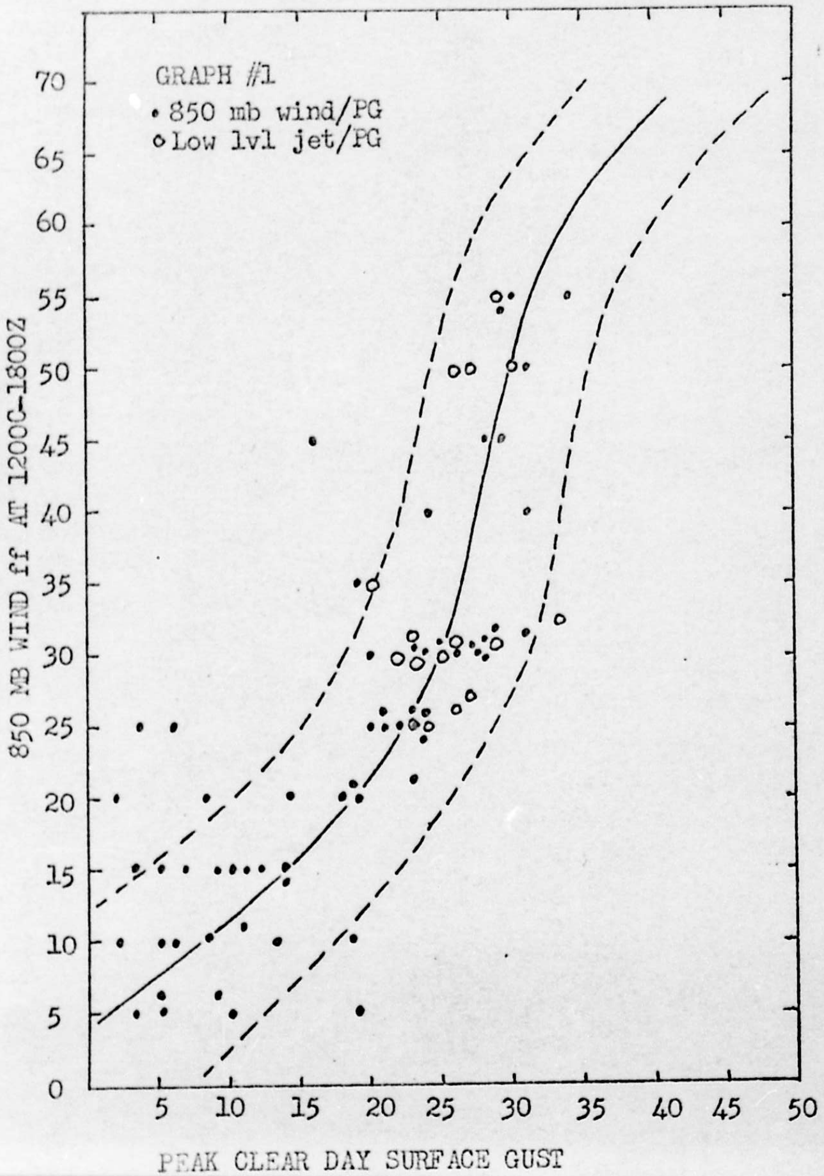
Step 4: Correct the forecast if the following situation exists. Normally, the clear day surface wind direction differs less than 45 degs.

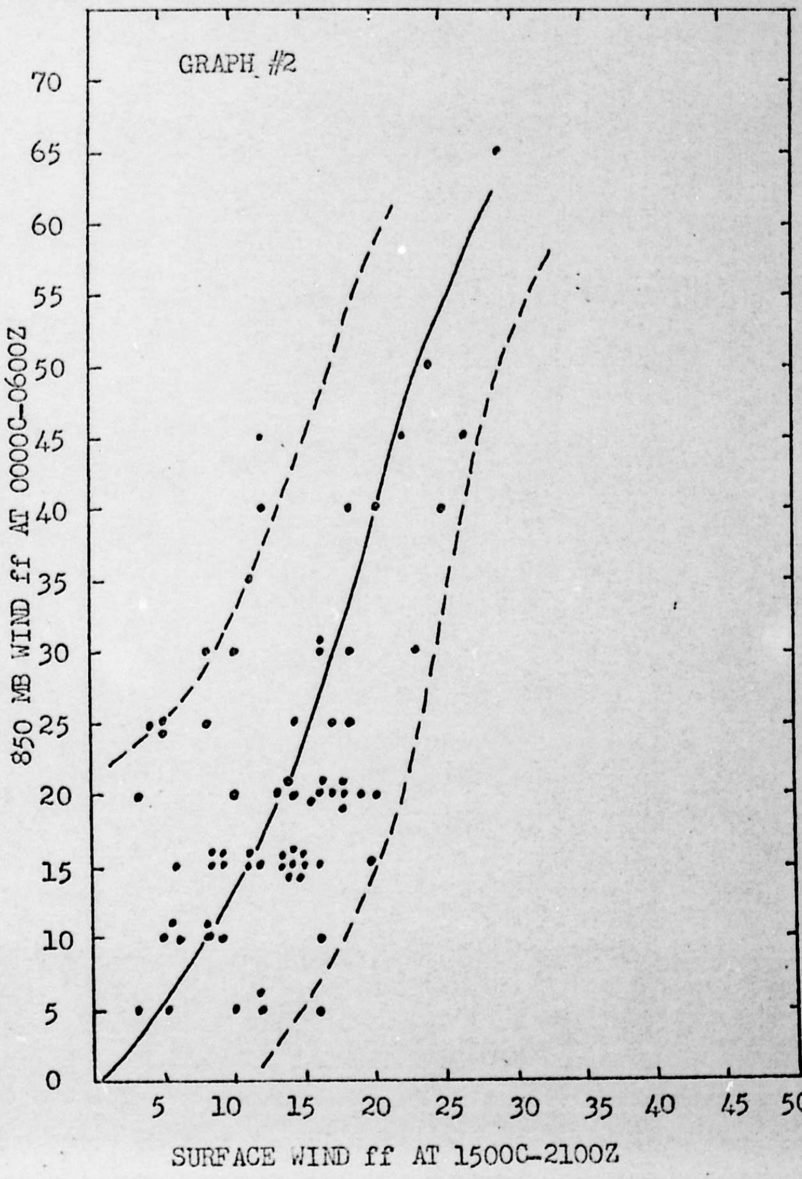
from the 1200C 850MB wind direction. The table is valid for those cases. When the wind direction difference is over 45 degrees, the forecast velocities tend to decrease from the values shown in the table. When the phase difference is expected to be over 90 degrees, the diurnal wind variation will be at a minimum.

FORECAST 1200C 850MB VELOCITY (ff)	FORECAST CLEAR DAY SURFACE VELOCITY (ff) +PEAK GUST (PG)
5	4 + 4
10	9 + 9
15	11 + 14
20	14 + 19
25	16 + 22
30	18 + 25
35	19 + 26
40	21 + 28
45	23 + 29
50	24 + 30
55	26 + 32
60	27 + 34
65	29 + 38

Note: There appears to be a fair correlation between the low level jet stream velocities and the peak clear day surface gustiness. As an interim measure during periods following the formation of a low level jet at some level below 850mbs, determine the max gust from the intersection of the velocity of the low level jet in graph #1, (along the solid curve) versus the peak clear day surface gust.

Note: Graphs are based on selected data for Tinker AFB, Oklahoma, e.g. no frontal passages or ceilings (low or middle clouds). All velocities are in knots.





TRIAL CORRELATIONS OF SURFACE WINDS WITH 850 MB WINDS

The following trials were performed during an attempt to attain an objective method of forecasting gusty surface winds under set conditions by correlation with the 850MB wind velocity and direction. The trials were all unproductive, but are herein stated as follows to prevent duplication in future studies:

a. The mean velocity of the 0300C 850MB and 0630C surface velocity was used as one coordinate versus the mean direction for the same velocity. The observed 1530C velocity and peak gust velocity were plotted with the idea of drawing isopleths of velocity and peak gust velocity.

b. The above procedure was tried using 1500C 850MB and 1530C surface winds, but the result was negative and it was concluded that wind direction has no important relation to wind velocity at Tinker.

c. Stability index was substituted in the above for the mean direction variable. The stability was expressed as the temperature difference between the 850MB temperature and the ambient surface temperature. The results were negative when using the 0300C 850MB and surface data, and when the 1500C relationship was tried it was noted that the clear day stability was about constant at 20°F to 25°F.

d. The above procedures were studied by separating the data according to backing or veering relations between the 850MB and surface direction. It was concluded that such a separation gains nothing since the clear day direction difference between the surface and 850MB is usually less than 45 degrees and the temporary variations in wind direction is too great to accurately sort backing from veering data.

LOCAL FORECAST STUDIES

SPECIAL SYNOPTIC STUDIES

TINKER AIR FORCE BASE, OKLAHOMA

CASE STUDIES OF
SELECTED SYNOPTIC CONDITIONS

1. Air Mass Frontal Systems

A not uncommon situation is the existence of 3 air mass frontal systems at Tinker AF Base (fig. 4-1). A cell of cold polar air moves southward to the east of the Rockies, warm moist tropical gulf air flows inland, and maritime polar air which has been dried out over the mountains moves eastward from the Mexico and New Mexico area.

In the gulf air there is a strong south-southeast flow of warm moist air, low stratus, fog, and often light rain or drizzle. The sounding for Oklahoma City at 1600Z 3 March 1944 is in the mT sector. Passage into the dry maritime polar air brings gusty southwest winds, blowing dust, clearing skies, and a sharp dew point drop, although temperatures remain high. A sounding in this air at Oklahoma City was not available, but the 3 March 0400Z sounding at Albuquerque is in this air mass. The cP air mass brings low temperatures and north-northwest winds; instability stratocumulus and, rain or snow showers. The 1600Z 3 March 1944 soundings for Albuquerque show the contrast of the 2 cold air masses. The Denver sounding of 1600Z 3 March also shows the low temperatures and near saturated conditions in the continental polar air. The cP air rapidly overtakes the mP front and the northern tip of the wedge of dry air seldom gets farther east than Oklahoma.

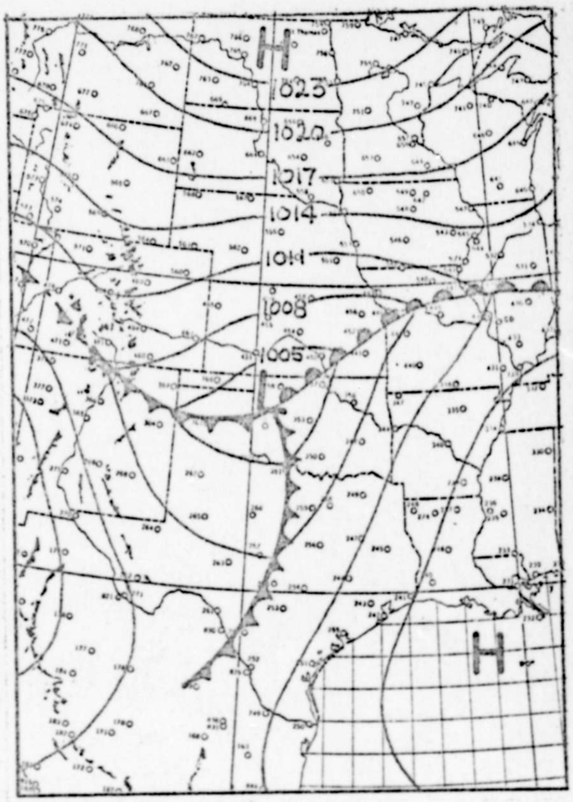


Figure 4-1. Surface Synoptic Map for 1830Z 3 March 1944. (5)

TABULATION 1

HOURLY SEQUENCE REPORTS FOR 3 MARCH 1944, TINKER AFB, OKLAHOMA

TIME CST	SKY COND	VSBY & WX	TEMP DW PT	WIND DIR	WIND VEL	ADDITIVE DATA
0030	50⊕		56/49	↑↖	35	804 1550
0130	13⊕		55/52	↑↖	33	
0230	15⊕		55/51	↑↖	29	
0330	26⊕	5H	56/53	↖	30	705 1500
0430	11⊕		56/53	↑↖	25	
0530	10⊕		56/52	↑↖	23	
0630	10⊕		56/53	↑↖	22	709 1500
0645	8⊕	5GF-	56/53	↑↖	22	
0710	4⊕	3F-	56/53	↑↖	22	
0730	4⊕	3F-	56/54	↖	24	
0830	5⊕	3F-	57/54	↖	25	
0930	5⊕	3F-	58/56	↑↖	28	602 1500
1030	5⊕	2F-	59/57	↑↖	30	
1130	5⊕	4F-	61/59	↑↖	29	
1230	5⊕	7	61/58	↑↖	28	
1240	8⦶15⦶		61/58	↑↖	30	
1330	20⦶/-⦶		67/58	↑↖	30	
1430	20⦶/⦶		71/50	↑↖	25	
1530	20⦶/⦶		72/44	→↗	25	715 1202
1630	25⦶	6BD-	72/44	→↗	35+	
1730	○	5BD-	72/43	→↗	20+	
1830	○	7	69/35	→↗	15	305
1930	○	7	67/30	↑↗	6	
2030	/⦶	6BD-	55/40	↓↘	25	
2130	/⦶	7	48/39	↘	25	224 1004
2230	/⦶		48/34	↘	24+	
2330	6⦶		40/31	↘	15	

TABULATION 2

HOURLY SEQUENCE REPORTS FOR 4 MARCH 1944, TINKER AFB, OKLAHOMA

TIME CST	SKY COND	VSBY & WX	TEMP DW PT	WIND DIR	VEL	ADDITIVE DATA
0030	6⦶		39/29	↘	20+	114 1100
0130	O		37/29	↓↘	22+	
0230	O		35/28	↓↘	25+	
0330	O		36/29	↓↘	25+	103
0430	15⦶		35/28	↓↘	20+	
0530	17⦶		36/29	↓	25	
0630	17⊕		36/30	↓↘	20	220 1500
0730	20⊕		35/28	↘	20	
0830	20⦶		35/28	↓↘	20	
0930	20⊕		35/29	↓	20	314 1500
1030	22⦶		38/28	↓↘	17	
1130	22⦶/⦶		42/30	↓↘	12	
1230	/⦶		44/30	↓	12	003 1504
1330	/-⦶		49/28	↓↘	12	
1430	/-⦶		49/27	↓↘	15	
1530	/-⦶		50/27	↓↙	8	708 1006

TABULATION 3

RADIOSONDE REPORTS

PP pressure	TT (°C) temperature	RH (%) rel. hum.	W mix. ratio
	ALBUQUERQUE: 0400Z 3 March 1944		
827	10	29	2.7
778	9	30	3.1
715	5	30	2.7
693	2	30	2.4
600	-10	50	1.6
500	-20	40	.7
465	-24		
400	-34		
	ALBUQUERQUE: 1600Z 3 March 1944		
830	1	87	4.3
810	0	60	3.2
774	-2	80	3.3
740	-4	80	3.1
690	-7	100	3.2
658	-9	100	2.8
631	-12	100	2.4
595	-17	90	1.7
524	-20	90	1.4
502	-21	70	1.1
462	-26	80	.8
435	-30	80	.7
400	-35	60	.3
	DENVER: 1600Z 3 March 1944		
830	-1	100	4.3
817	-3	100	3.7
772	-6	100	3.2
690	-8	100	2.9
670	-8	100	3.0
600	-14	100	2.1
527	-20	100	1.4
460	-29	100	.8
400	-37	100	.4

TABULATION 3 (contd)

PP	TT (°C)	RH (%)	W
	OKLAHOMA CITY: 1600Z 3 March 1944		
962	14	95	9.7
945	14	100	10.3
915	14	100	11.0
855	12	90	9.5
840	13	80	9.8
832	14	80	9.7
775	11	30	4.0
712	5	50	4.5
697	4	50	4.1
610	-3	20	1.2
595	-4		
505	-12		
475	-17		
400	-27		
	OKLAHOMA CITY: 1600Z 4 March 1944		
975	4	68	3.4
815	-3	75	2.5
745	4	45	2.9
710	8	35	2.6
650	6		
600	-2		
500	-9		
507	-17		
472	-22		
400	-31		

2. Gulf Stratus

On rather infrequent occasions, the gulf stratus of the coastal area extends as far north as Tinker AFB (tabulation 3). The night of 27 October 1961 is an example of such an occurrence. The strong southeasterly flow brought in cooler moist air in the levels just above the surface. The resultant stratus deck forms in Texas and gradually extends northward with ceilings between 800 and 1600 feet; the top of the stratus layer seldom exceeds 4,000 feet MSL. On this day the confluence in this area (see figs 4-3a and 4-3b) at 850 mbs has caused the stratus to be more persistent than is usually indicated.

TABULATION 3

HOURLY SEQUENCE REPORTS FOR SELECTED STATIONS, 27 OCTOBER 1961

0000C-0600Z

DAL	○15 56/37↑↖10
BAD	○15 44/37 CALM
PNX	○15 51/43↖7
ADM	○15 48/37←↙3
SPS	○15 52/34↑10
ICT	/-⦶15 52/31↑14
OKC	○15 50/34↑↖10+18
TIK	/⦶12 49/33↑↖12
PNC	/-⦶15 53/27↑↖10

0100-0700Z

DAL	○15 55/37↑↖10
BAD	○15 42/35 CALM
PNX	○15 50/35↖9
ADM	○15 48/38↖3
SPS	○15 51/34↑9
ICT	○15 51/31↑13
OKC	○15 48/34↑15
TIK	/⦶15 50/33↑↖13
PNC	○15 52/26↑↖15

0200C-0800Z

DAL	○15 54/38↑↖11
BAD	○15 45/35↖2
PNX	○15 49/35↑↖6
ADM	○15 47/38↖2
SPS	18⦶10 51/36↑↖8
ICT	○15 51/31↑16
OKC	○15 45/34↖12
TIK	/⦶15 49/33↑↖9
PNC	MSG

0300C-0900Z

DAL	30⊕15 54/38
BAD	○15 41/34↖5
PNX	○15 48/34↖7
ADM	30-⦶15 47/37←↖3
SPS	26⊕15 52/39↑12
ICT	○15 50/31↑↖13+22
OKC	○15 46/35↑↖13
TIK	○15 50/35↑↖16
PNC	○15 50/27↖12

TABULATION 3-CONT'D

0400C-1000Z

DAL	33⊕15 53/39↑10
BAD	○15 43/34←2
PNX	37-⊕15 49/35↖6
ADM	39⊕15 51/37↖8
SPS	25⦶15 52/40↑↖10
ICT	/-⦶15 49/32↑↖12+18
OKC	24⊕15 50/36↑↖10+18
TIK	40⦶15 51/35↑↖11
PNC	○15 50/28↑13

0500C-1100Z

DAL	30⦶15 53/40↑7
BAD	○15 42/34 CALM
PNX	37⊕15 50/36↖6
ADM	15⊕15 51/38←↖4
SPS	○15 52/42↑↖10
ICT	/-⦶15 49/32↑18
OKC	17⊕15 52/37↑↖13+20
TIK	30⊕15 52/36↑12
PNC	○15 49/29↑16

0600C-1200Z

DAL	30⦶90⦶15 51/41↑↖7
BAD	○15 41/34↓3
PNX	37⊕15 51/36↑7
ADM	15⊕15 54/38←↖4
SPS	16⦶/⦶15 52/41↑8
ICT	27⦶/⊕15 49/33↑17+24
OKC	18⊕15 52/38↑↖12+20
TIK	24⊕15 52/37↑↖14
PNC	30⦶15 50/30↖10+19

0700C-1300Z

DAL	29⊕15 53/42 ↑7
BAD	/-⦶15 40/35 CALM
PNX	37⊕15 52/36↑↖8
ADM	32⊕15 54/38↖5
SPS	15⊕15 52/42↑↗5
ICT	20⦶15 51/35↑21
OKC	15⦶23⊕15 53/39↑↖10+19
TIK	20⊕15 52/38↑↖13
PNC	25⊕15 51/32↖15

0800C-1400Z

DAL	30⊕15 55/42↑11
BAD	/-⦶15 46/37←↖4
PNX	22-⦶42⊕15 53/37↑↖10
ADM	25⊕15 55/39←↖4
SPS	15⊕15 56/46↑↖11
ICT	30⦶/⊕15 52/38↑18+25
OKC	12⊕15 54/41↑↖14+25
TIK	14⊕15 53/40↑14
PNC	20⦶/⊕15 52/33↑12+20

1000C-1600Z

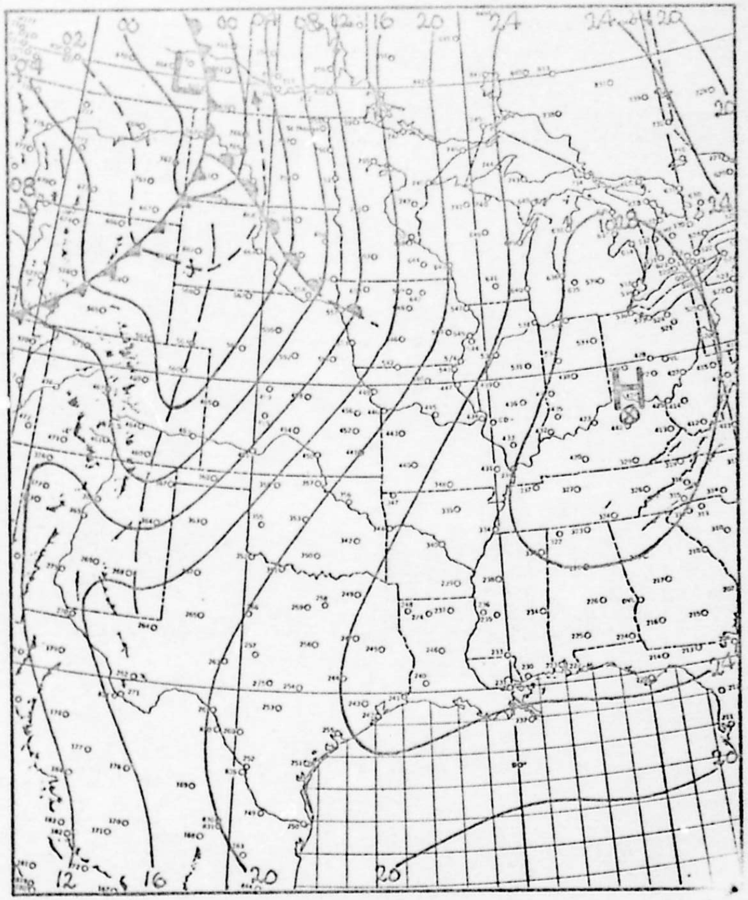
DAL	30⊕15 61/42↑12
BAD	○15 61/32↑↖10
PNX	27⦶/⊕15 60/37↑13
ADM	25⦶120⦶15 61/39↑↖10
SPS	17⦶/⊕15 58/48↑20+27
ICT	25⊕70⦶15 55/41↑22+32
OKC	15⦶45⊕15 57/45↑↖13+23
TIK	16⊕7R-- 55/42↑14+20
PNC	25⦶/⊕15 56/39↑↖12+20

1200C-1800Z

DAL	30⊕15 67/45↑15
BAD	/-⦶15 68/34↖7
PNX	30⦶/⊕15 66/44↑13
ADM	25⦶100⦶/⊕15 64/44↑↖14
SPS	19⊕100⦶/⊕10 63/50↑18

1200C-CONT'D

ICT	38⦶80⦶/⊕15 59/47↑25+40
OKC	30⦶110⦶/⊕15 61/47↑↖18+28
TIK	40⦶100⦶/⊕15 58/45↑19+27
PNC	40⊕100⊕15 61/45 ↑↖18+28



PSWC 5A

Figure 4-2a. Surface Synoptic Map for 1800C

26 October 1961.

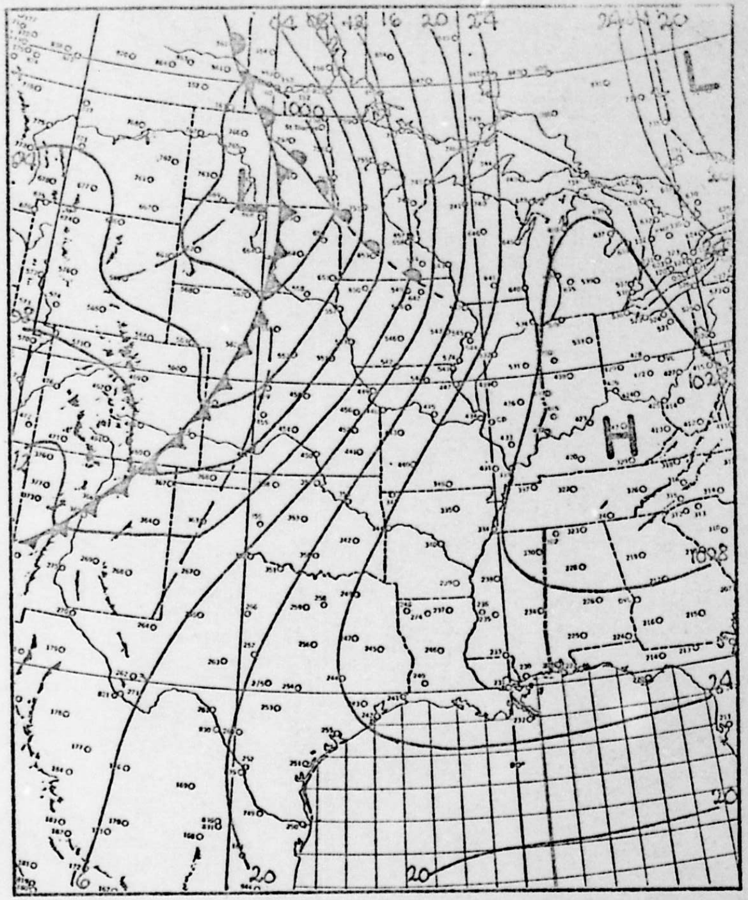


Figure 4-2b. Surface Synoptic Map for 0600C

27 October 1961.

87-0754

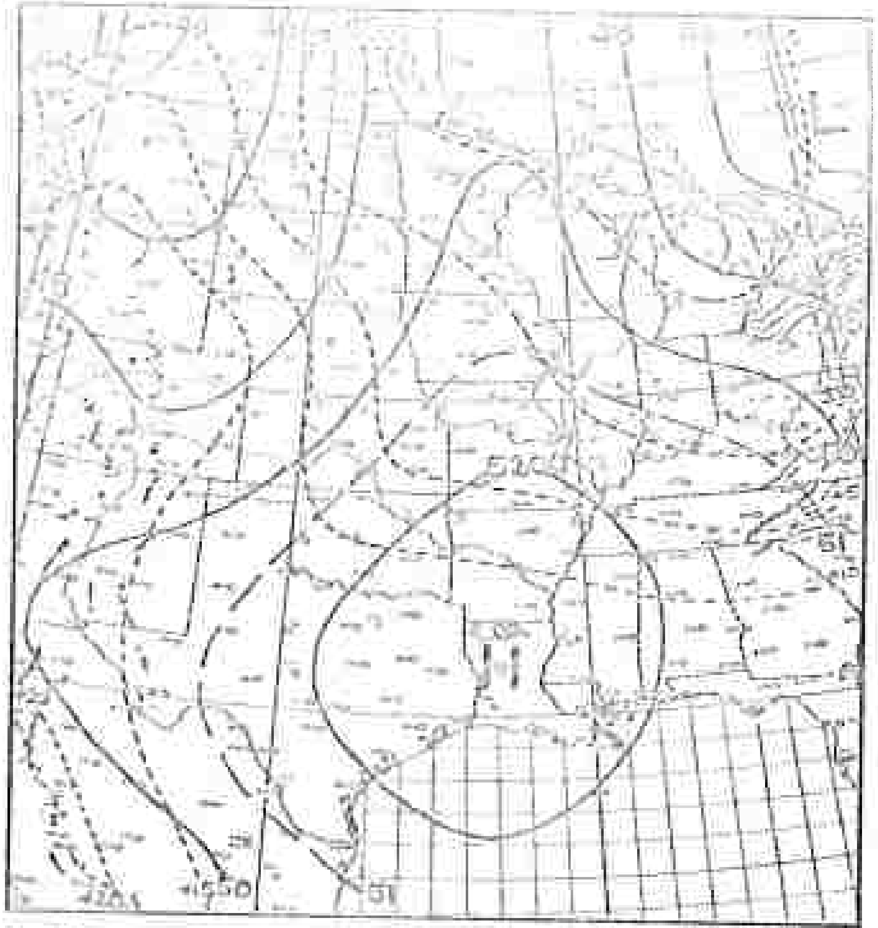


Figure 4-3a. 850MB Chart for 1800G 26 Oct 1961.

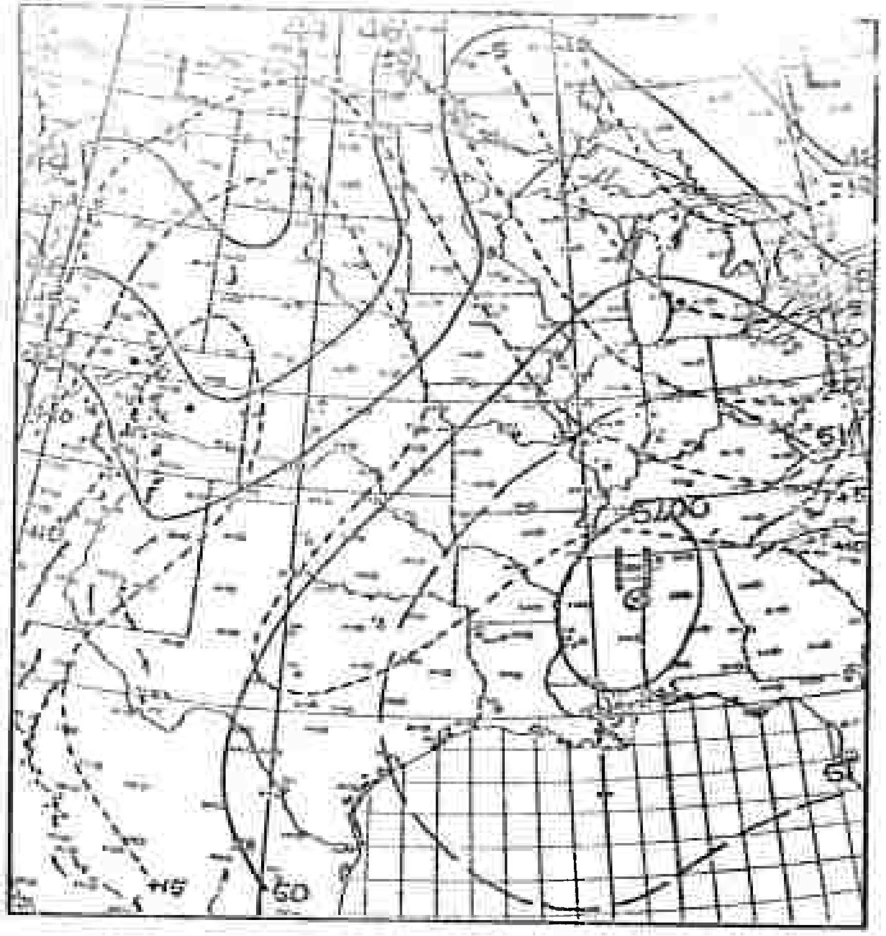


Figure 4-3b. 850MB Chart for 0600G 27 Oct 1961.

87-0754

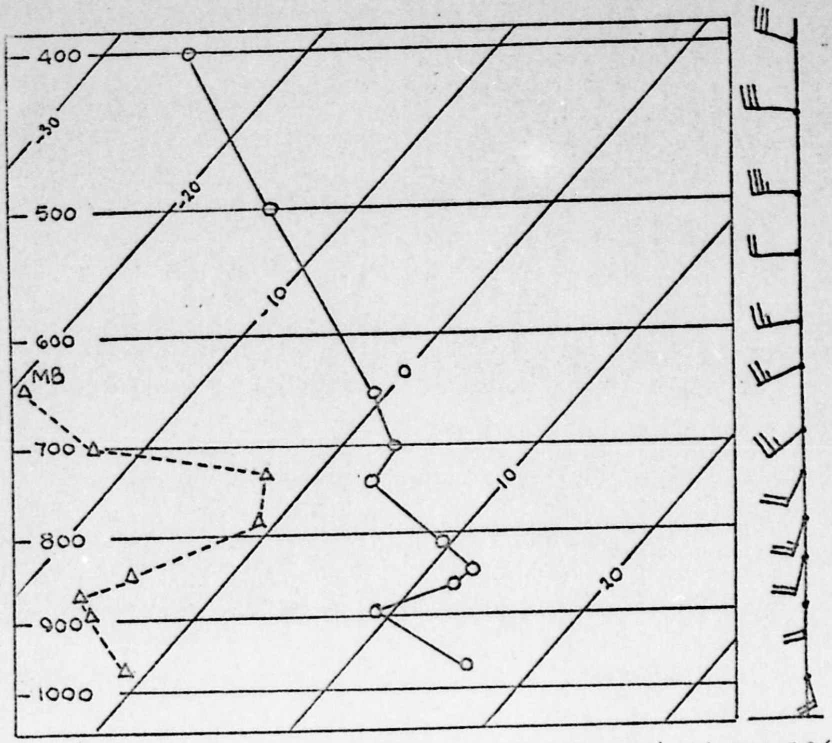


Figure 4-3c. Oklahoma City sounding for 0000Z (1800C) 26 Oct 1961.

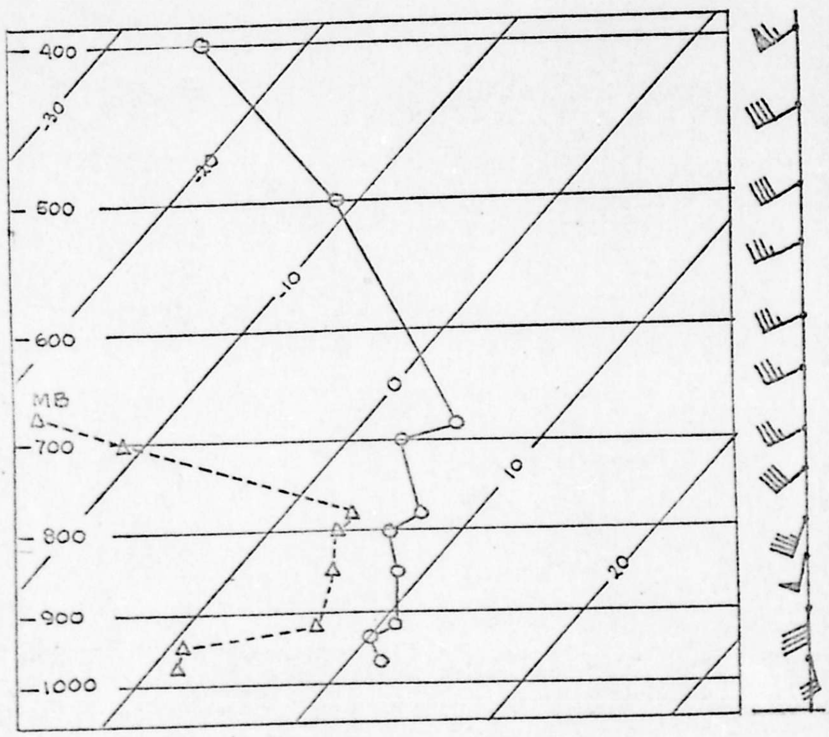


Figure 4-3d. Oklahoma City sounding for 1200Z (0600C) 27 Oct 1961.

3. Bad Weather Situation in Winter

On 2 February 1959 a cP cold front had passed through Oklahoma and lay just off the Gulf coast of Texas. The cold high was centered over northern Illinois at the surface and Tinker was in a general upslope condition throughout the day. Aloft a closed low was centered over the southern California-Arizona border at 500 mbs. The turning of the winds in the lower layers to the south, plus the addition of moisture from the overrunning flow aloft resulted in increasingly lower ceilings and visibilities. The warm precipitation from the mT air falling into the shallow wedge of freezing air near the surface produces an extremely hazardous freezing precipitation, with low stratus and fog, and in this case was briefly accompanied by overrunning thunderstorms. This stratus and fog is very persistent since the slowly warming air remains saturated in the lower layers. Only the passage of the upper trough brought relief from this situation. The accompanying figures which follow show the synoptic and upper conditions during this bad weather period.

HOURLY SEQUENCE REPORTS FOR TINKER AF BASE

TIME CST	CEILING & SKY	VSBY	WX	TEMP/DEW PT.	WIND	REMARKS
		2 FEBRUARY 1959				
0000C	M15⊕	15		20/15	N12	
0100C	E70⊕	15		20/15	NNE12	
0200C	P4X	1	S-	19/15	NNE15	
0300C	P3X	1	S-	16/13	NNE14	PIASOR
0400C	E8⊕	8	S--	16/13	NNE13	
0500C	P4X	2	S-	16/13	NNE13	
0600C	M40⊕	10		16/13	NNE10	90401
0700C	M40⊕	10	S--	16/13	NNE9	
0800C	M33⊕	9		16/13	NNE7	
0900C	M32⊕	12		17/12	N8	
1000C	M34⊕	12		17/14	NNE9	
1100C	8⦶M34⊕	8	ZL--	18/16	N9	
1200C	M8⦶34⊕	8	ZL--	20/17	N8	PIASOR
1300C	M9⊕	10		19/17	N8	PRESFR
1400C	11⦶M17⊕	12		21/19	NNE7	
1500C	M21⊕	12		22/19	N6	PIASOR
1600C	M17⊕	12		22/18	N4	
1700C	M16⊕	12		23/18	N4	
1800C	M9⊕	7		23/19	N3	PIASOR
1900C	M2⊕	2	ZL--F	21/19	WNW4	CIG RGD
2000C	M2⊕	2	ZL--F	21/19	CALM	
2100C	W2X	11/2	ZL--F	21/19	CALM	PIASOR
2200C	W2X	1	ZL--F	24/22	CALM	
2300C	W2X	1	ZL--F	23/21	CALM	

TIME CST	CEILING & SKY	VSBY	WX	TEMP/DEW PT.	WIND	REMARKS
		3 FEBRUARY 1959				
0000C	W2X	1	ZL--F	23/22	CALM	CIASOR
0100C	W2X	7/8	ZL--F	23/22	SW4	
0200C	W2X	1	ZL--F	23/22	SW6	
0300C	W2X	21/2	ZL--F	23/22	SSW6	CIASOR
0400C	3⦶E30⊖	4	T AP	23/22	S10	T OVHD MOVG EWD APB 44 HLSTO 1/8
0500C	M4⊕	4	T ZL-	25/24	S10	PRESFR
0600C	M4⊕	7		26/25	SSW10	CIASOR
0700C	M4⊕	10		26/25	SW8	
0800C	-XM4⊖	5	F	25/24	SW11	F1
0900C	-X2⊖	13/4	F	25/24	WSW12	F4
1000C	M5⊕	6	F	26/25	WSW13	
1100C	M5⊕	6	F	26/25	WSW10	
1200C	M12⊕	10		31/28	W10	
1300C	15⦶	15		33/28	WNW12	
1400C	150⦶	15		35/28	NW14+20	
1500C	/⦶	15		37/24	N15+22	
1600C	150⦶/-⊕	15		38/24	N13	CU ALQUADS
1700C	140⦶/-⊕	15		37/26	N12+19	
1800C	/-⊕	15		37/25	N10	
1900C	/⦶	15		35/25	NNW7	
2000C	CLEAR	15		33/25	N5	
2100C	CLEAR	15		33/25	CALM	
2200C	CLEAR	15		31/24	CALM	
2300C	CLEAR	15		28/22	CALM	
0000C	CLEAR	15		28/22	CALM	

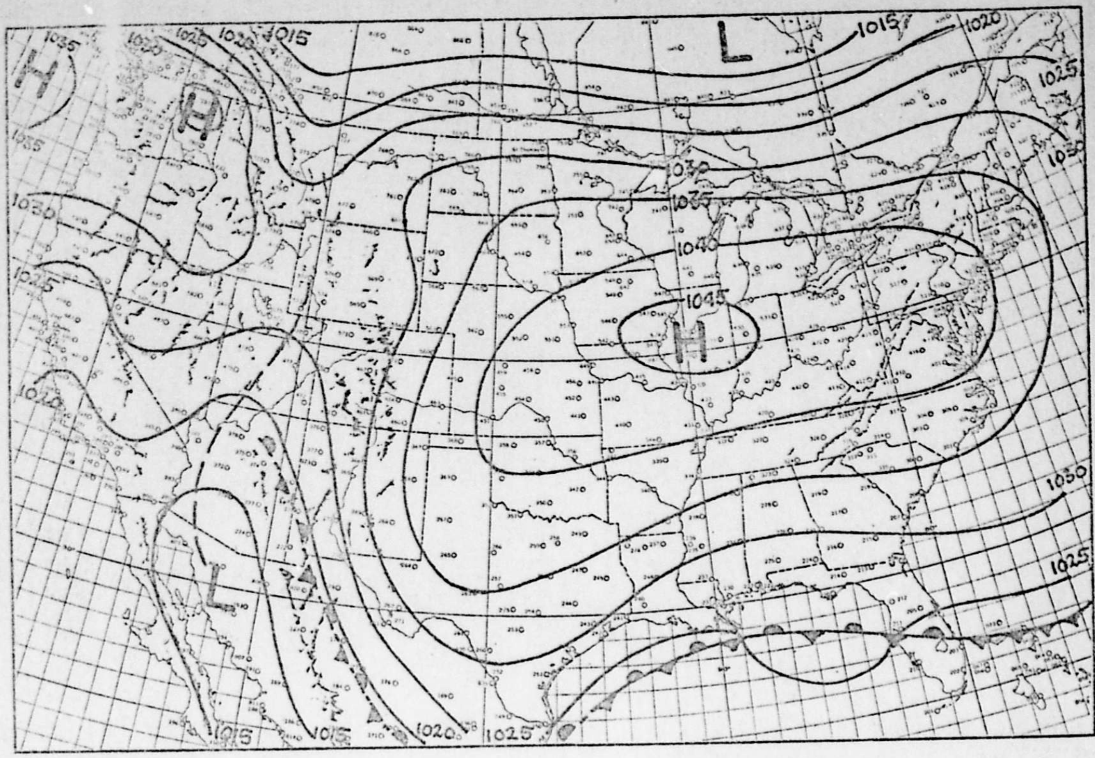
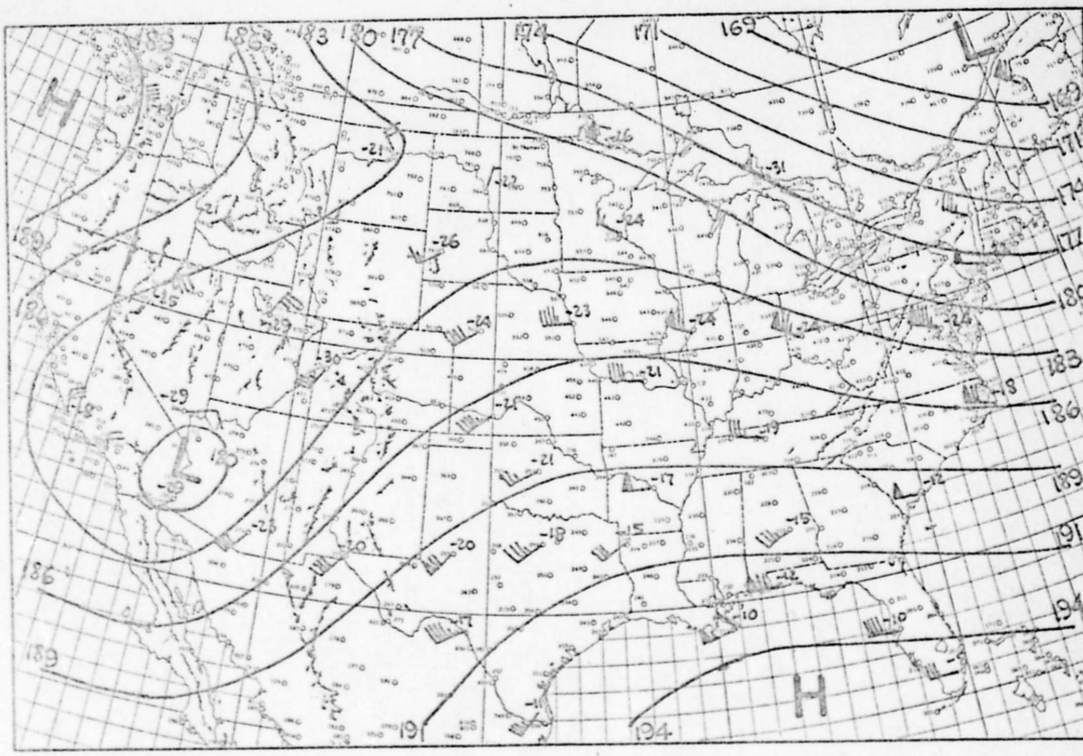


Figure 4-5. Surface Synoptic Map for 1230Z (0630C) 2 February 1959.



P5WC 2A

Figure 4-6. 500MB Chart for 1200Z (0600C) 2 February 1959.

57-0753

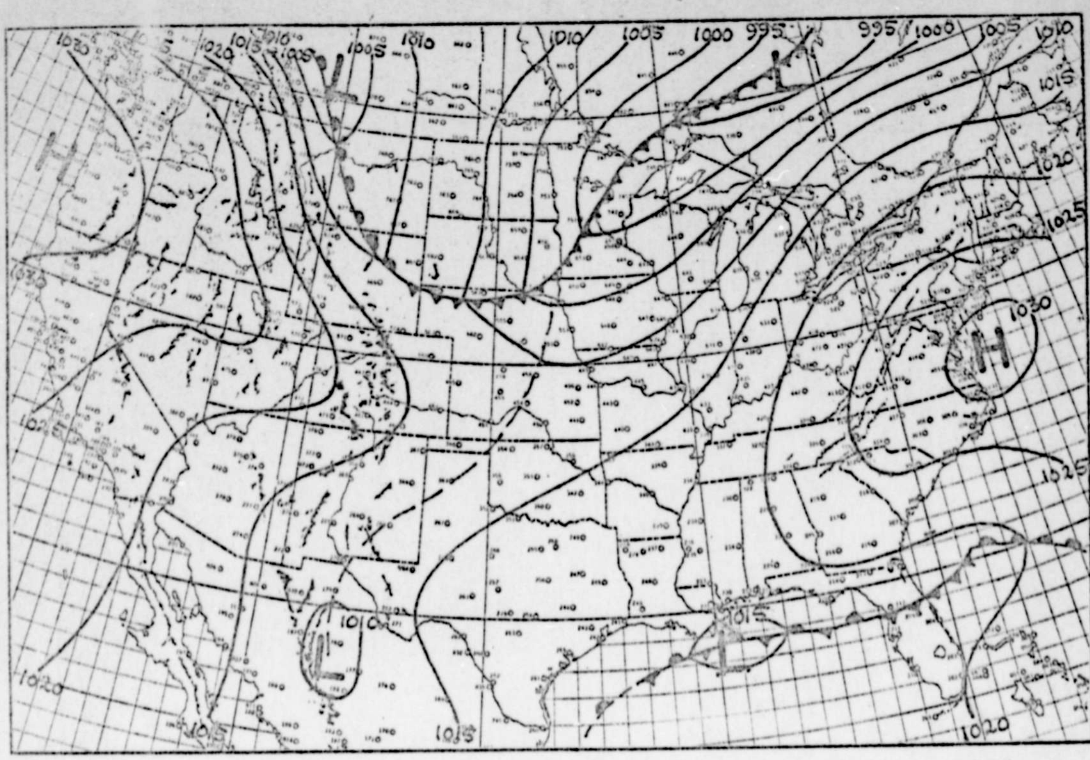
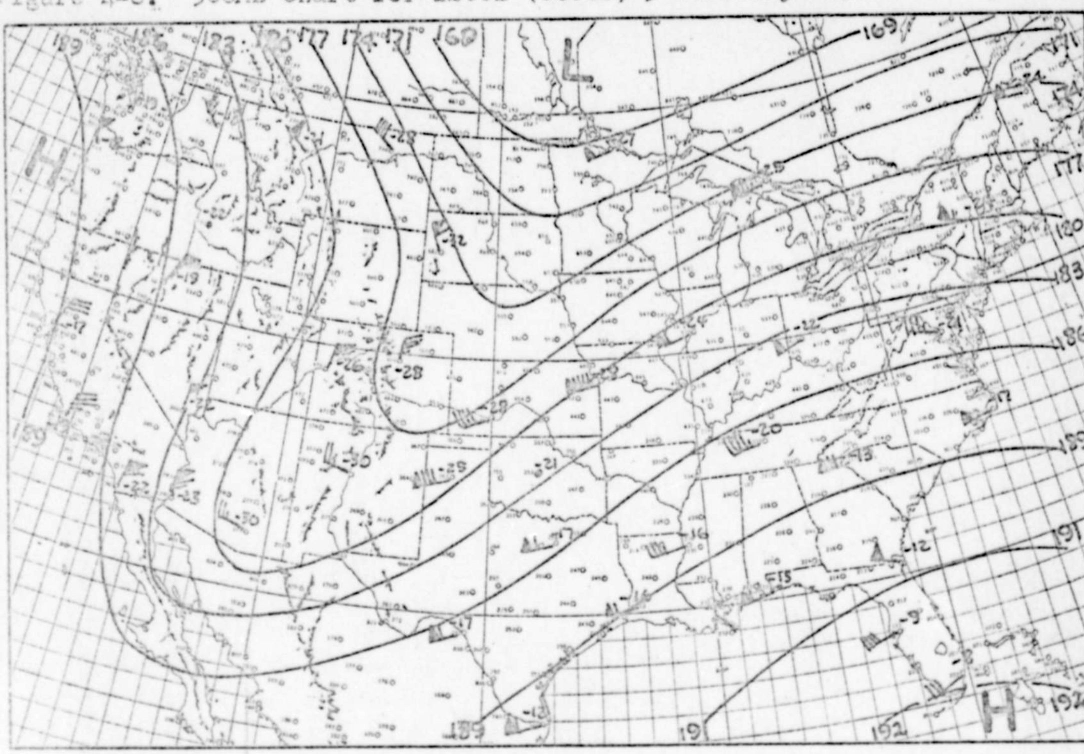


Figure 4-7. Surface Synoptic Map for 1230Z (0630C) 3 February 1959.

Figure 4-8. 500MB Chart for 1200Z (0600C) 3 February 1959.



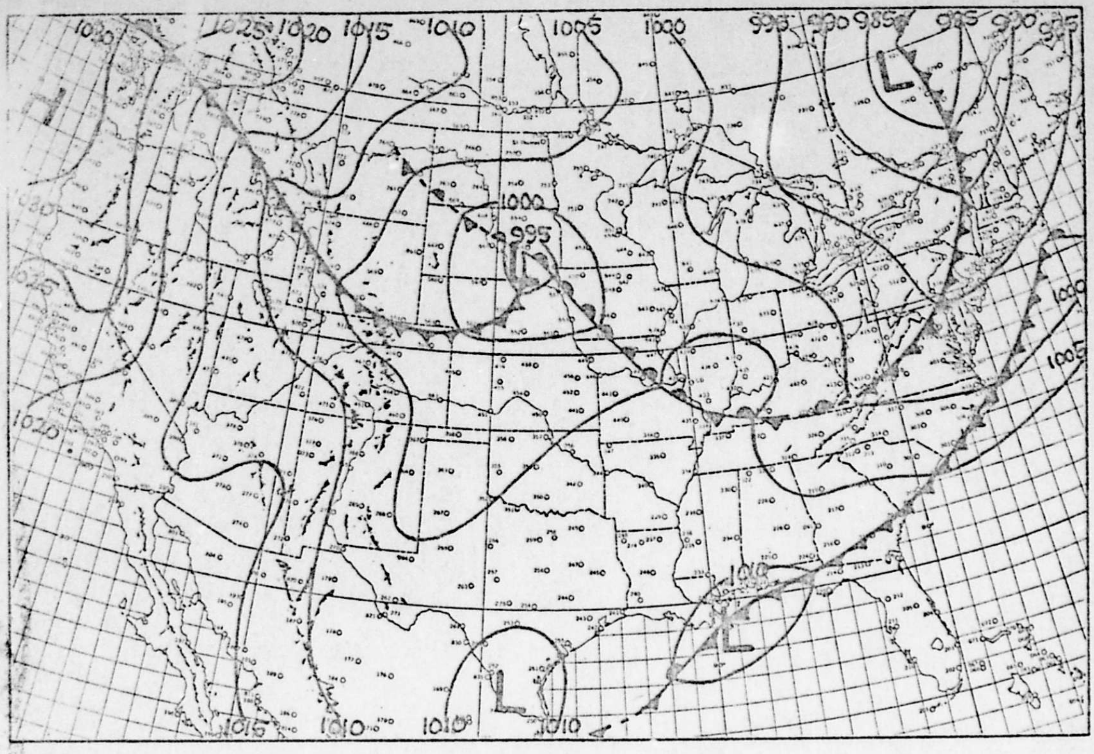
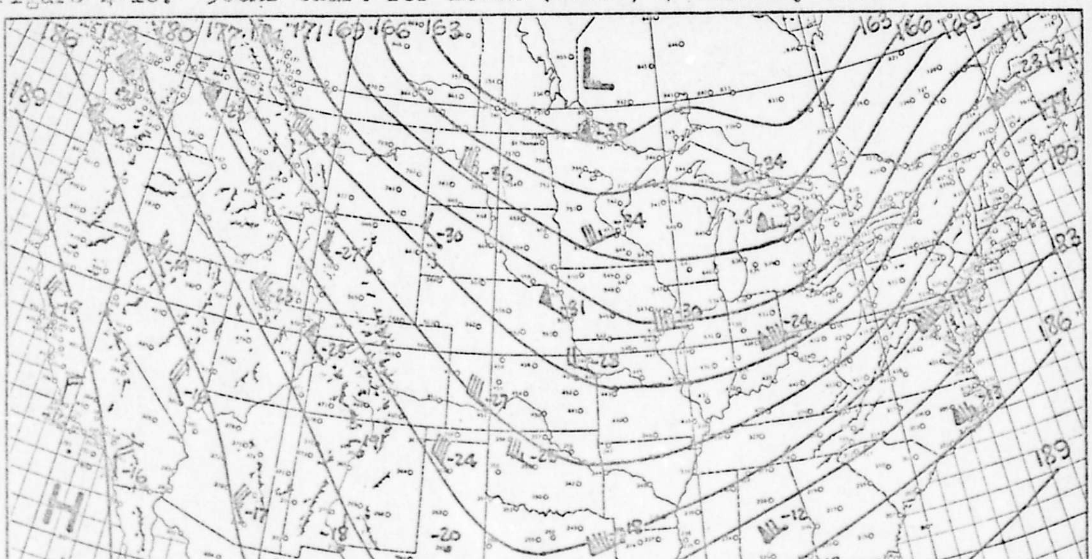


Figure 4-9. Surface Synoptic Map for 1230Z (0630C) 4 February 1959.

Figure 4-10. 500MB Chart for 1200Z (0600C) 4 February 1959.



4. A Spring Thunderstorm Situation

The period from 3-5 May 1960 is an excellent example of the quasi-stationary mP-mT front to the west of Tinker and the resultant weather associated with this synoptic pattern. Heavy thunderstorms occurred on all three days: on the first two days triggered by squall lines, and finally along with the frontal passage on 5 May. The near saturation of the air in the lower levels is evidenced by the presence of Gulf stratus on 4-5 May and also reflected on the accompanying charts. This storm system is summarized very well in the "Monthly Weather Review" for May 1960:

"Much of the cool weather (over the western U.S.) was the result of a single storm system which developed in the Southwest about May 4. This storm brought heavy rains, hail, and high winds to many sections, tornadoes in Oklahoma and Arkansas, and heavy snowfall in Wisconsin, Upper Michigan, and the eastern slopes of the Colorado Rockies. Dubuque, Iowa reported 4.38 inches of rain in a 24-hour period on the 5th and 6th. Snowfall amounts of 3 to 5 inches were common in much of Wisconsin and Upper Michigan. At Oklahoma City, Okla., a wind speed of 72 mph exceeded the previous record for any May."

Following is a summary of events recorded in this area of the intensity of the storms in this area during the period 3-5 May 1960:

3 May	2000C	Golf ball size hail reported in the southern part of Oklahoma City.
3 May	2205C	Funnel cloud reported 6 miles north of Norman-did not touch the ground. Very large hail reported with thunderstorms in the vicinity.
4 May	1935C	Winds estimated at 80 MPH in the western portion of Oklahoma City injured one woman, extensive wind damage.
4 May	1955C	Tornado or tornadoes struck Bethany, Okla and Tulakes Airport (now Wiley Post). In Bethany 12 homes were destroyed and 25 were extensively damaged, 5 persons were injured. At the airport considerable damage was reported.

TABULATION

HOURLY SEQUENCE REPORTS FOR 3 MAY 1960, TINKER AFB, OKLAHOMA

TIME	SKY CONDITION	VSBY	WX	TEMP DP	WIND	REMARKS
0100	○	15		57/45	↑10	
0200	○	15		56/45	↑9	
0300	○	15		55/45	↑8	
0400	○	15		54/45	↑9	
0500	○	15		53/44	↑7	
0600	○	15		51/44	↑8	
0700	○	15		53/45	↑10	
0800	○	15		60/47	↑↗10	
0900	/⦶	15		65/52	↑↗13	
1000	35⦶/⦶	15		67/53	↑↗13+17	
1100	35⦶	15		69/54	↑↗11	
1200	35⦶/⊕	15		72/53	↑13+18	
1300	35⦶/⊕	15		72/53	↑13	
1400	35⦶/⦶	15		74/52	↑14+20	
1500	/⦶	15		75/53	↑14+18	
1600	○	15		77/52	↑↖14+19	
1700	/⦶	15		75/50	↑14+19	
1800	100⦶/-⦶	15		73/51	↑15+20	
1900	120⦶/⊕	15		71/52	↑13	
2000	120⦶/⊕	15		70/52	↑12	
2100	30⦶80⊕	15		69/53	↑13	FQT DSNT LTNG PRESRR
2118	30⦶80⊕	15	TRW--		↑11	TW MOVG NEWD FQT LTGICCC
2200	30⦶80⊕	12	TRW-	68/54	↑10	T OVHD MOVG NEWD FQT LTGICCCCG
2245	20⊕	3	T+RW+		↗10	T OVHD MOVG NEWD FQT LTGICCCCG
2300	P7X	2 1/2	TRW+	62/59	↑8	T OVHD MOVG NEWD FQT LTGICCCCG
2330	10⊕	7	TRW-A		↙10	T OVHD MOVG NEWD FQT LTGICCCCG HLSTO 1/8
2400	10⦶30⊕	9	TRW-	61/55	↙9	T NE MOVG NEWD FQT LTGICCCCG

Figure 4-11. Surface Synoptic Chart for 1200C 3 May 1960.

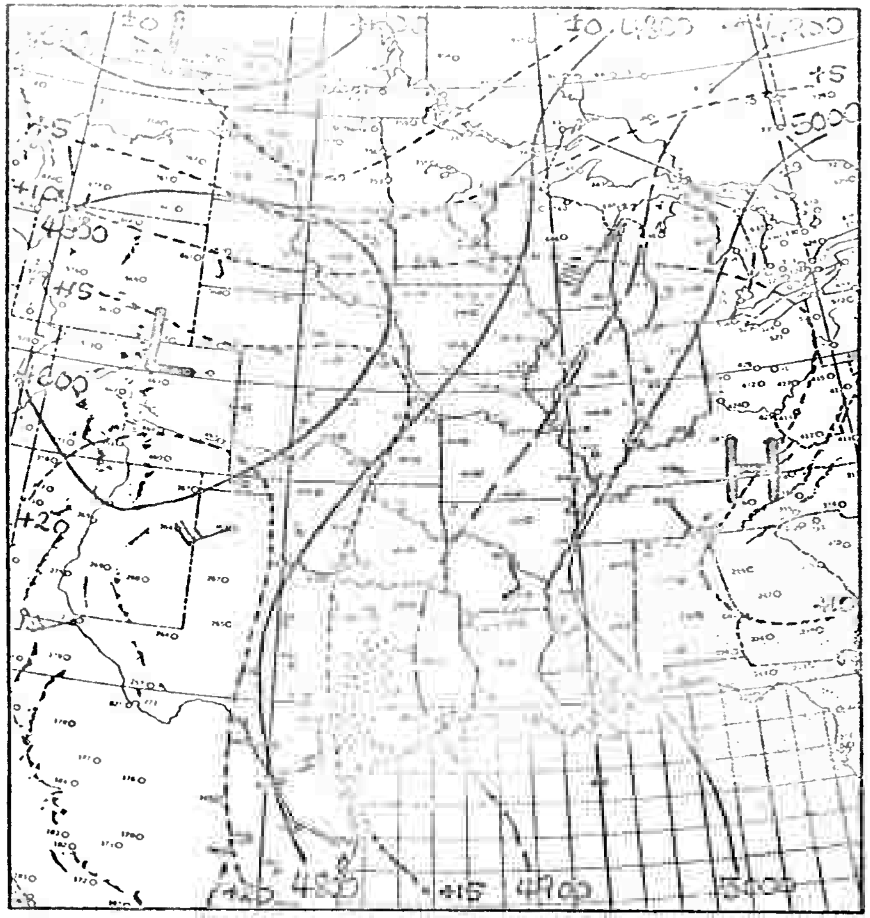


Figure 4-12a. 850MB Chart for 1800C 3 May 1960.

legend:

Temp-dew point spread less than 2°C.

Temp-dew point spread less than 4°C.

Figure 4-12b. 500MB Chart for 1800C 3 May 1960.

S7-0754

TABULATION

RADIOSONDE REPORT

PRESSURE (MB)	TEMPERATURE °C	RH (%)	HEIGHT (M)
1000			59
963	23.5	48	392
853	13.1	67	1420
850	13.9	47	1461
845	15.1	21	1500
700	4.3	32	3073
500	-15.8	17	5705
426	-23.0	18	6870
400	-27.0	16	7347
300	-43.8		9353
296	-44.4		9440
250	-52.7		10555
202	-61.6		11900
200	-61.3		11965
150	-58.5		13774
100	-57.1		16309
50	-56.5		20679
25	-50.4		25154

Tabulation 4-13. Radiosonde for Oklahoma City, 1800C (0000Z) 3 May 1960.

TABULATION

HOURLY SEQUENCE REPORTS FOR 4 MAY 1960, TINKER AFB, OKLAHOMA

TIME	SKY CONDITION	VSBY	WX	TEMP DP	WIND	REMARKS
0100	10⌽30⊕	10	TRW-	63/56	←↖13	T SE MOVG NEWD OCNL LTGIC
0200	30⌽/⌽	15		61/55	↖12	OCNL LTGIC SE
0300	27⊖	15		62/57	↑↖16	
0400	12⌽27⊖	15		64/59	→6	
0500	12⌽27⌽	15		62/59	↑↖9	
0600	12⌽27⌽/⊕	10		63/60	↑13	
0610	12⌽27⊖	3	F		↑14	
0617	-X21⊖	2	L--F		↑14	
0700	8⌽30⌽	4	F	64/60	↑14	
0800	12-⌽30⌽	10		65/60	↑15+22	
0900	21⌽/⌽	10		65/60	↑14+21	
1000	16-⌽21⌽	10		66/60	↑12+21	
1100	12⊕	9	L--	65/61	↑14+21	
1108	9⊖	3	RW--F		↑14+23	
1200	10⌽30⌽	9		66/63	↑10+16	
1300	21⌽30⊖	12		68/62	↑12+20	
1400	22⌽30⊕	15		69/62	↑10+17	
1500	22⌽26⊖	15		71/62	↑12+18	
1600	40⌽/⊕	15		72/62	↑13+21	
1700	40⌽80⌽/⊕	15		70/62	↑12+20	TWRG CU ALQDS
1800	40⌽70⊕	15		71/63	↑11	
1900	30⌽60⊖	12	TRW--	71/63	↖8	T SW MOVG NEWD CB NE
1947	P10X	11/2	T+RW+		→↗23+37	T ALQDS MOVG NEWD FQT LTGICCCCG
2000	15⊕	2	TRW+	54/51	↗13+37	T ALQDS MOVG NEWD FQT LTGICCCCG
2004	P10X	2	T+RW+A		↖7+22	HLSTO 1/4
2055	90⊖	15	TRW--	59/52	↖3	T OVHD MOVG NEWD OCNL LTGICCCCG
2200	90⊖	15		55/53	↖9	T G37 MOVD NE OCNL LTGICCCCG SE AND W
2300	120⊖	15		56/53	←9	OCNL DSNT LTNG NE THRU SE
2400	120-⌽	15		56/54	←↖8	

Figure 4-14. Surface Synoptic Chart for 1200C 4 May 1960.

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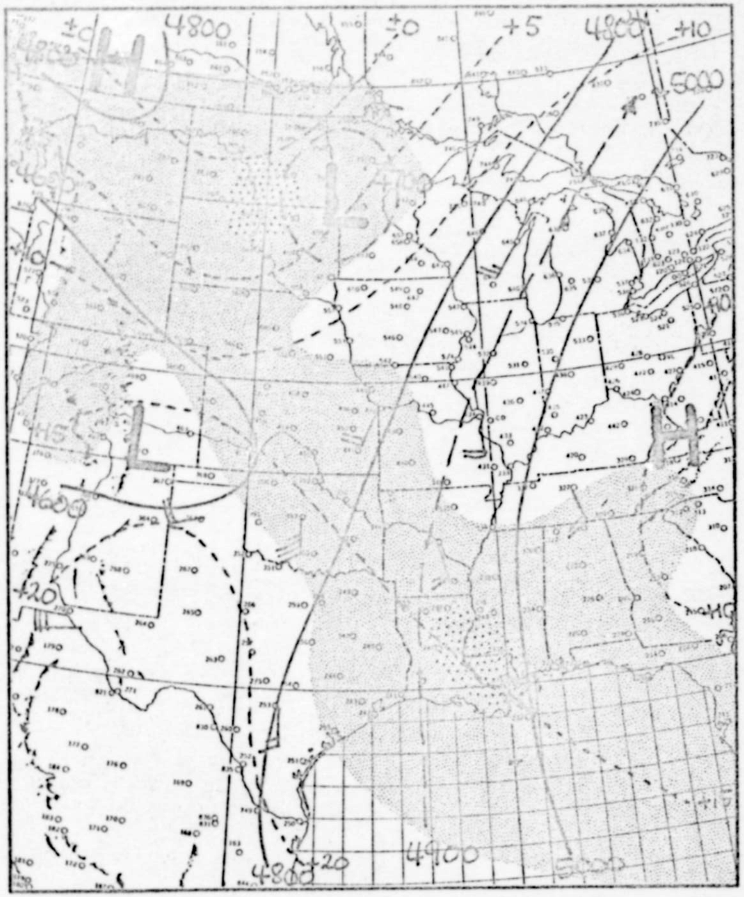

PSWC 5A

Figure 4-15. 850MB Chart for 1800C 4 May 1960.

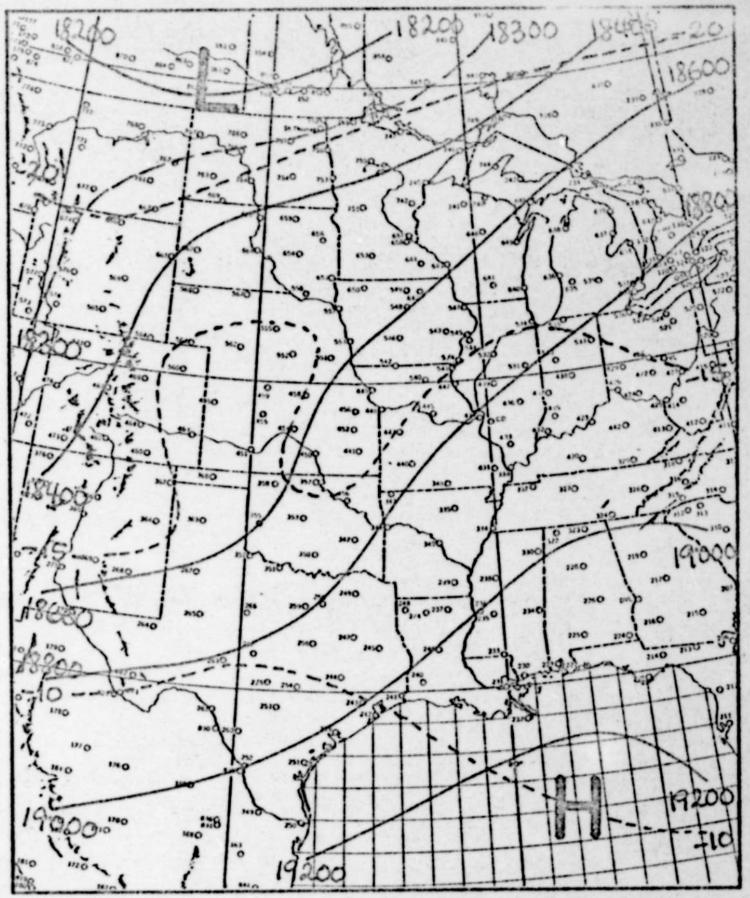

Figure 4-16. 500MB Chart for 1800C 4 May 1960.

legend:

Temp-dew point spread less than 2°C.

Temp-dew point spread less than 4°C.

S7-0754

TABULATION

RADIOSONDE REPORT

PRESSURE (MB)	TEMPERATURE°C	RH (%)	HEIGHT (M)
1000			41
960	21.2	81	392
850	14.0	83	1436
713	3.9	90	2900
700	1.4	81	3043
692	0.0	78	3140
681	-0.6	44	3260
670	+3.4	37	3400
500	-17.2	67	5860
484	-19.5	71	5900
400	-26.6	72	7320
300	-41.0		9339
250	-50.2		10557
200	-60.7		11977
172	-54.1		12930
150	-55.8		13798
100	-60.0		16346
77	-60.9		17974

Tabulation 4-17. Radiosonde for Oklahoma City, 1800C (0000Z) 4 May 1960.

TABULATION

HOURLY SEQUENCE REPORTS FOR 5 MAY 1960, TINKER AFB, OKLAHOMA

TIME	SKY CONDITION	VSBY	WX	TEMP DP	WIND	REMARKS
0100	12⌽30⌽	15		56/54	←↖10	
0200	12⌽30⌽	15		55/53	↖10	
0300	30⌽	15		56/53	↖9	
0400	30⌽	15		57/53	↖10	
0500	30⌽	15		58/55	↖9	
0600	14⊕	10		61/57	↑11	
0700	11⊕	7		62/59	↑11	
0800	11⌽	7		65/62	↑↗13	
0900	11⌽	7		66/62	↑↗13+18	
1000	11⌽	7		71/64	↑↗11+16	
1100	20⌽	7		74/65	↑↗11	
1200	20⌽/⌽	10		76/66	↑11	
1300	20⌽/⌽	10		79/65	↑↖10	
1400	25⌽40⊕	10	RW-	77/65	↑↖12	PRESFR
1444	25⊕	5	TRW-		↑↖11+17	T SW MOVG NEWD OCNL LTGICCC ALQDS
1500	25⊕	5	TRW-	72/66	↑↖14+19	TB 43 T SW MOVG NEWD OCNL LTGICCC ALQDS
1502	P15X	2	TRW+		↑↖14+19	T SW MOVG NEWD OCNL LTGICCC ALQDS
1600	15⌽25⊕	7	TRW	67/60	↑↖10+17	T NW MOVG EWD OCNL LTGIC NW
1613	15⌽25⊕	3	TRW		↑↖8+13	TB 59 N MOVG EWD OCNL LTGIC
1700	15⌽30⊕	9	T	65/62	↖3	T SE THRU W MOVG EWD OCNL LTGICCC
1722	15⊕	21/2	TRW		←5	T S THRU NW MOVG EWD FQT LTGICCCCG
1800	15⌽30⊕	7	RW-	66/63	↓↘10	T G19 MOVD E OCNL LTGIC E
1900	12⌽30⌽100⊕	9	TRW-	65/62	←↖3	T NW MOVG NEWD OCNL LTGICCC
2000	12⌽35⊕	9	TRW-	64/61	↓6	T S MOVG EWD OCNL LTGICCC
2100	12⌽35⌽90⊕	9	T	63/61	C	T E THRU S MOVG EWD OCNL LTGICCC
2121	35⌽90⌽/⌽	15			↓↘6	OCNL LTGIC E THRU S
2134	2⌽35⊕	9			↓11+15	
2200	3⊕	9		62/60	↓↘7	
2300	40⌽90⌽	15		61/59	C	
2400	90⌽	15		61/59	←↖3	

Figure 4-18. Surface Synoptic Chart for 1200C 5 May 1960.

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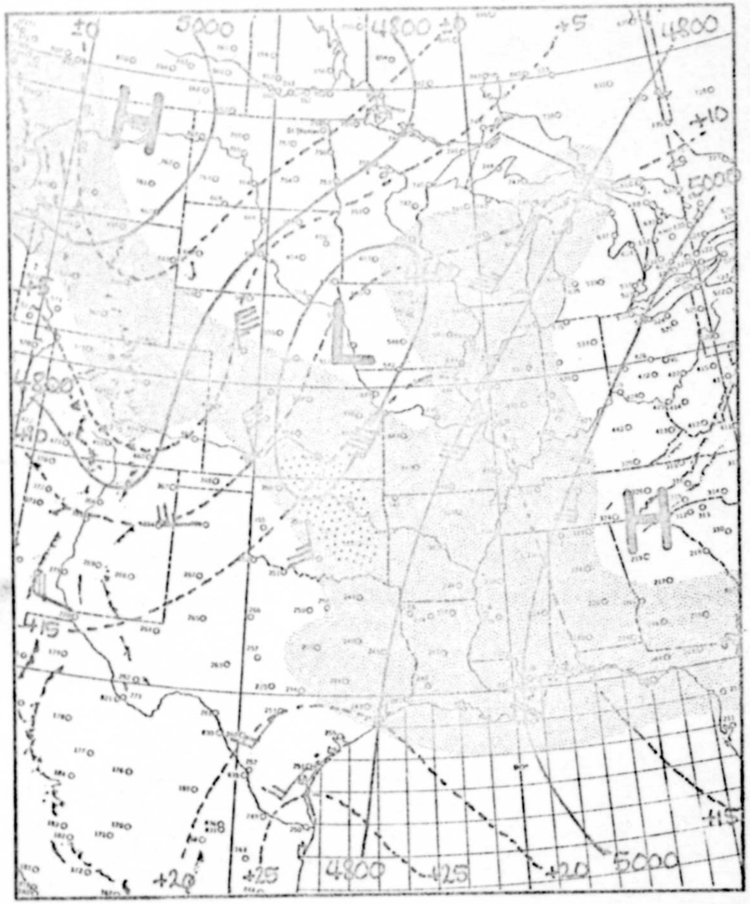


PSWC 5A

Figure 4-19. 850MB Chart for 1800C 5 May 1960.

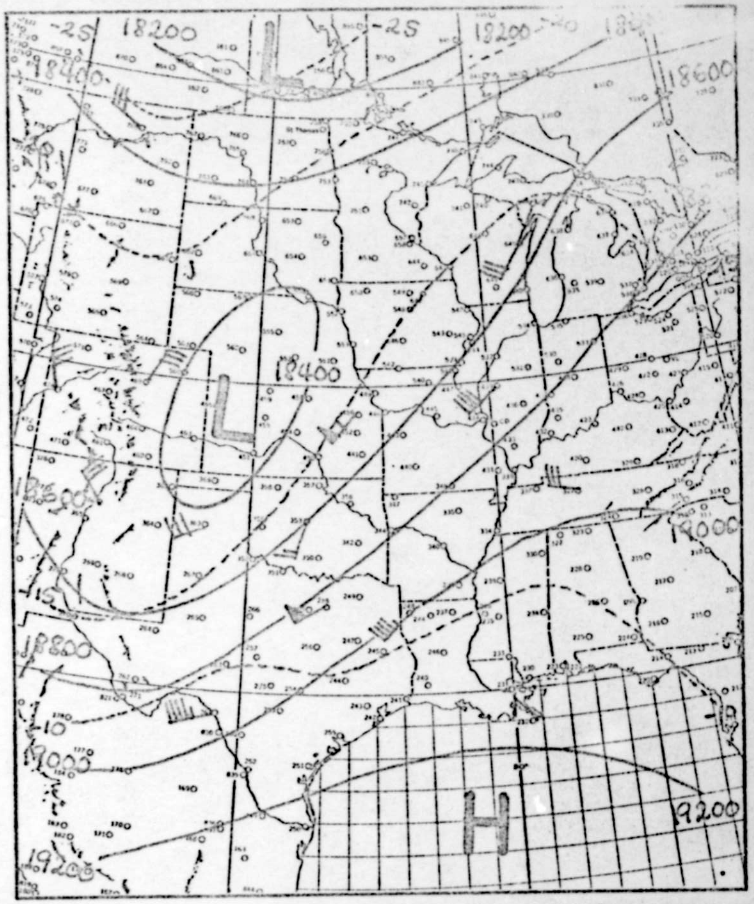


Figure 4-20. 500MB Chart for 1800C 5 May 1960.

legend:

Temp-dew point spread less than 2°C.

Temp-dew point spread less than 4°C.

S7-0754

TABULATION

RADIOSONDE REPORT

PRESSURE (MB)	TEMPERATURE °C	RH (%)	HEIGHT (M)
1000			9
955	19.4	91	392
928	16.5	89	630
850	15.3	94	1386
844	15.1	95	1460
700	5.9	100	3009
583	-1.6	95	4500
557	-1.3	91	4870
500	-6.9	87	5708
400	-19.5	67	7416
272	-42.4		10151

Tabulation 4-21. Radiosonde for Oklahoma City, 1800C (0000Z) 5 May 1960

5. Strong Gusty Surface Winds

The map of 17 June 1944 (fig 4-22) shows a good example of the strong super-gradient surface winds that occur at Tinker AF Base. Comparative values through this area emphasize the super-gradient winds at Tinker, especially in view of those at Fort Smith, Ardmore, Enid, and Amarillo. Although the winds aloft at Tulsa show comparative values, the surface wind velocities are much less. The slight diurnal shift from south-southeast to south-southwest is also apparent from 16-18 June 1944. The Oklahoma City RAOBS (fig 4-25) show the characteristic dry layer aloft which limits cloud development and the diurnal change in the lower layers from stability to instability. The strongest winds normally occur each day at the approximate time that the low level inversion is wiped out (0930-1130LST).

TABULATION

HOURLY SEQUENCE REPORTS FOR TINKER AIR FORCE BASE

TIME		WIND			WIND			WIND	
CST	SKY	DIR	VEL	SKY	DIR	VEL	SKY	DIR	VEL
	16 JUNE			17 JUNE			18 JUNE		
0030	O	SSE	18	O	SSE	25+	O	SSE	22
0130	O	SSE	20	O	SSE	25+	O	SSE	22
0230	O	SSE	19	O	SSE	25	O	SSE	22
0330	O	S	22	/-⦶	SSE	21	O	S	22
0430	O	S	23	/-⦶	SSE	22	/-⦶	S	21
0530	O	S	21	/-⦶	SSE	25	/-⦶	SSE	19
0630	O	S	19	/-⦶	SSE	20	O	SSE	18
0730	O	SSW	20	/-⦶	SSE	23	O	SSE	25+
0830	O	SSW	24	/-⦶	SSE	25	O	S	25+
0930	O	SSW	20	O	SSE	27	O	SSW	28+
1030	O	S	26	O	S	30	O	SSW	25+
1130	O	S	27	O	S	26	O	S	26
1230	O	S	26	40⦶	SSE	29	40⦶	SSW	18
1330	O	S	25	40⦶	SSE	20	50⦶	S	20
1430	O	S	27	40⦶	SSE	30	50⦶	SSW	22
1530	O	SSE	24	40⦶	SSE	28	50⦶	S	23
1630	O	SSE	25	40⦶	SSE	26	50⦶	SSE	20
1730	O	SSE	20	O	SSE	28	50⦶	SSE	20
1830	O	SSE	20	O	SSE	26	50⦶	SSE	20
1930	O	SSE	15	O	SSE	20	50⦶	S	19
2030	O	SSE	14	O	SSE	18	40⦶	S	14
2130	O	SSE	19	O	SSE	20	40⦶	S	14
2230	O	SSE	20	O	SSE	22	40⦶	SSE	16
2330	O	SSE	22	O	SSE	20	35⦶	SSE	14

SURFACE WIND VELOCITY FROM THE HOURLY SEQUENCE REPORT
17 JUNE 1944

	TIK	FSM	TUL	OKC	LTS	WNK	GAG	TUL	ADM	END	PNC	ICT	ABQ
0030	22	8	12	18	12	16	25+		10	10	17	18	18
0130	25+	6		18	11	13	24+	22	09	10	15	17	17
0230	25+	10	13	22	9	16	20-	23	10	9	19-	20-	17
0330	25	7	12	19		20-		21	4	10	15	22	22
0430	21	9	12	18	13	19-	18	18	3	10	15	25	20
0530	22	5	7	16	12	17	14	20	3	10	15	18-	20
0630	25	8	7	19	8	14	14	22	4	11	13	19-	23
0730	20	8	6	21	4	16	16	23	4	10	19	16	19
0830	23	6	7	21	10	17	17	18	9	12	15	21-	20
0930	25	6	13	25+	14	17	20	25	10	13	17	22-	27
1030	27	5	13	28+	17	25+	20	28	12	18-	23	23+	30
1130	30	7	16	24	17	20-	25+	27	14		19	27+	31
1230	26	7	22	25+	16	20-		26	15	16-	13	29+	24
1330	29	9	18-	26+	13	26+	25+	25	13		23	26+	20
1430	20	8	19-		18	22+	25+	25	18		25	21-	21
1530	30	10	20-	29+	16	19+	21		15		23	23+	23
1630	28	10	20-	26+	15	24+	28+	31	20	17-	23	26+	20
1730	26	11	18-	31+	16	20+		27	16	19+	25+	24+	21
1830	28	11	18-	23+	18	22+	20-	29	13		23-	25+	20
1930	26	12	12	24+	22	23+	23+	29	17	19+	29+	28+	17
2030	20	11	14	28+	21	22+	18	29	11	19+	23+	22+	15
2130	18	11	12	18	14	15	16	24	10	14	19+	18-	20
2230	20	11	18-	13	14	15		25	9	14	17	15	16
2330	22	12	12	15	13	16	16	24	6	10	17	15	20

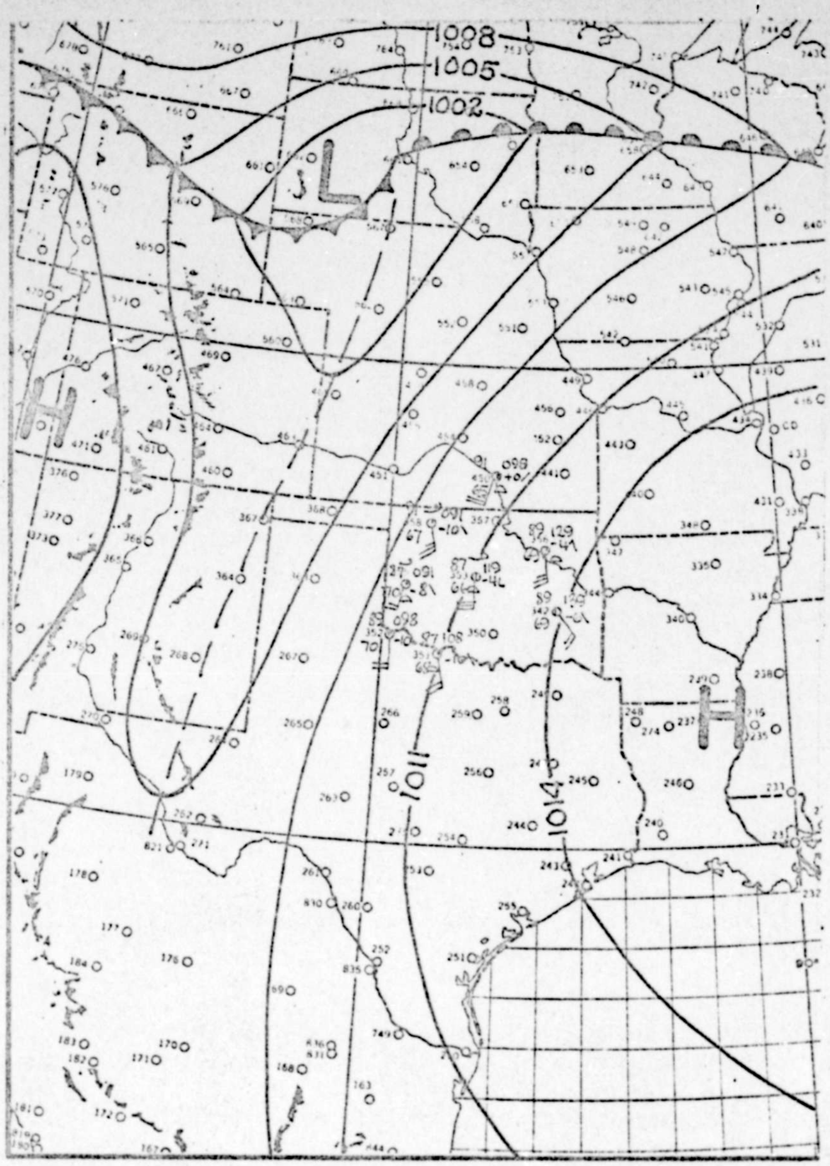


Fig. 4-22. Surface Synoptic Chart for 1830Z 17 June 1944.

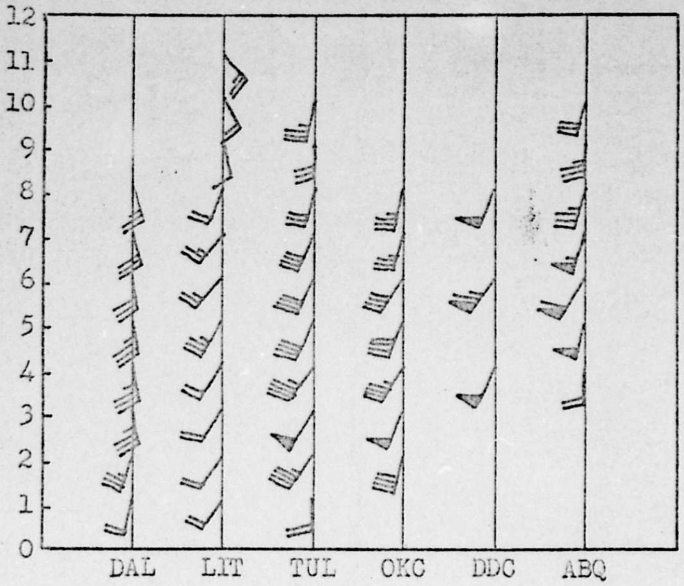


Fig. 4-23. Winds aloft for 1115Z on 17 June 1944.

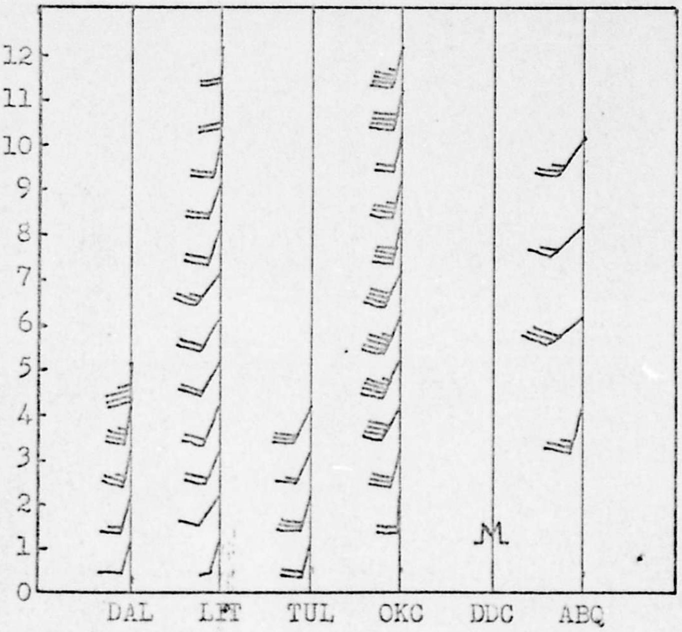


Fig. 4-24. Winds aloft for 1730Z on 17 June 1944.

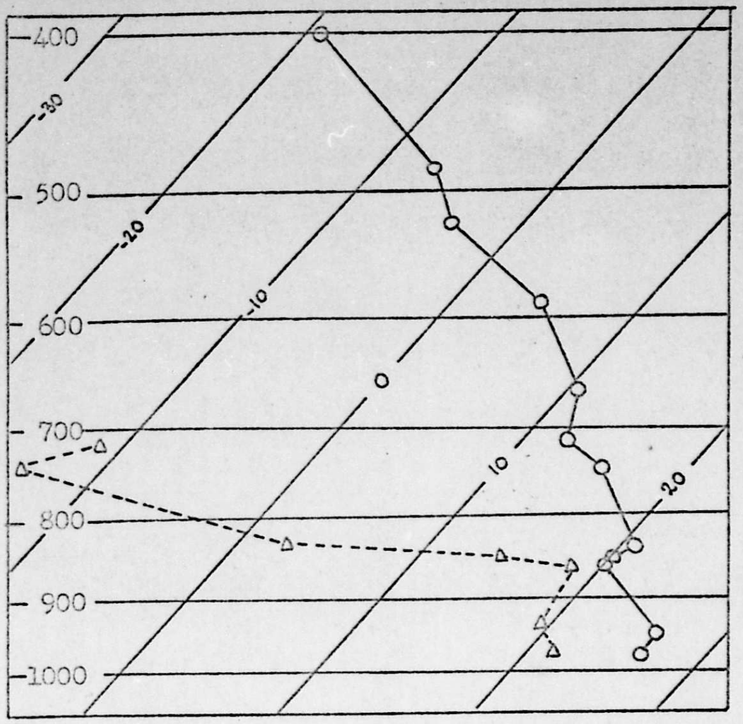


Figure 4-25. Oklahoma City sounding for 0605Z 17 June 1944.

6. A Typical Summer Day at Tinker Air Force Base, Oklahoma

The tenth day of August 1961 represents a usual summer day with a diurnal temperature range of approximately 20°F; the diurnal wind shift is south or south-southeast into the south-southwest with increased velocity and gustiness during the period of insolational heating. This day has a diurnal cloud pattern of scattered cumulus; the RAOB shows relatively high moisture content to 8,000 feet then a sharp drop to drier air above; the winds-aloft pattern indicates south to southwesterly winds up to 10,000 feet-strongest in the gradient layer but dropping rather sharply above 10,000 feet. There is light turbulence in the afternoon.

TABULATION

HOURLY SEQUENCE REPORTS FOR 10 AUGUST 1961, TINKER AFB, OKLAHOMA

TIME (CST)	SKY COND	VSBY	TEMP/DEW PT	WIND DIR	WIND VEL	ADDITIVE DATA
0100	○	15	79/62	↑	16	
0200	○	15	78/63	↑	15	
0300	○	15	76/65	↑	15	103
0400	○	15	77/64	↑	16	
0500	○	15	75/64	↑	14	
0600	/-⌽	15	75/65	↑	14	310 1056
0700	/-⌽	15	76/66	↑	17	
0800	/-⌽	15	81/68	↑↗	18	
0900	/-⌽	15	85/68	↑↗	19	105 1008
1000	/-⌽	15	88/67	↑↗	20	
1100	/-⌽	15	91/67	↗	18+23	
1200	/-⌽	15	92/68	↗	19	002 1108
1300	/-⌽	15	93/68	↑↗	18	CU BLDG ALQDS
1400	40⌽/-⌽	15	95/67	↗	18	
1500	30⌽/⌽	15	95/65	↑↗	18	807 1108
1600	30⌽/-⌽	15	95/66	↑↗	14+23	
1700	30⌽/-⌽	15	95/67	↑	12+20	
1800	○	15	93/66	↑	14	
1900	○	15	89/66	↑	15	
2000	○	15	85/67	↑↖	16	
2100	○	15	83/67	↑↖	15	310
2200	○	15	81/67	↑↖	14	
2300	○	15	80/67	↑↖	14	
2400	○	15	79/66	↑↖	14	114

TABULATION

PIBALS FOR OKLAHOMA CITY, 10 AUGUST 1961

HEIGHT FEET	0600C DD	0600C VV	1200C DD	1200C VV	1800C DD	1800C VV	11/0000C DD	11/0000C VV
2,000	190	20			180	15		
4,000	230	35			180	15		
6,000	220	15			200	20		
8,000	250	05			200	10		
10,000	060	05			050	05		
12,000	050	10			060	10		
14,000	040	10			050	10		
16,000	030	15			060	10		
20,000	010	10			070	10		

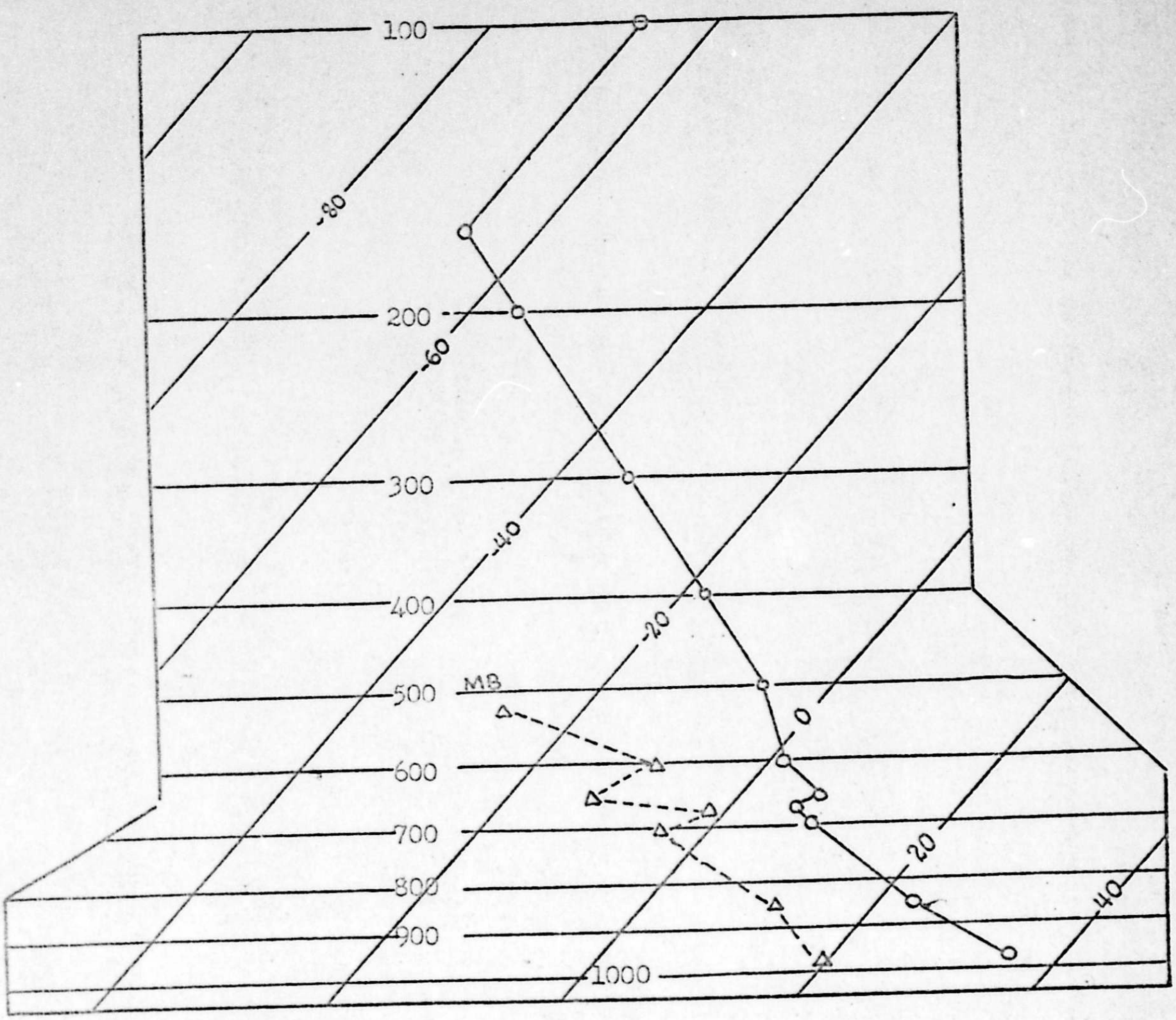


Figure 4-26. Sounding for Tinker AFB, Oklahoma at 1800Z 10 Aug 1961.

7. Tornado Composite Charts

Composite charts for the surface, 850 mb, 700 mb, and 500 mb levels for Oklahoma and the Texas Panhandle have been prepared for tornado occurrences in this area (8). Cases selected for inclusion in these composite charts were mostly based on the occurrence of three or more tornadoes within the outlined area during a period of 12-hours. In all, 66 individual cases were used in the preparation of these charts with a total of 449 tornadoes reported.

These charts will provide a means for identifying larger-scale features which are common to these situations. Also, composite charts clearly depict anomalies or departures from the "norm". These charts will not fit every "severe weather" situation in this area, but will provide a basic tool in forecasting this type of weather. Several rules of thumb used by forecasters in this area are also validated by these charts, they will be listed below.

The interest in preparing the charts was in family type outbreaks rather than isolated occurrences, so that tornado situations were selected on the basis of the occurrence of several tornadoes. A tornado situation was originally defined as one in which 3 or more tornadoes occurred within a specific area and at least two of these were separated by a distance of 100 miles or more. The tornado situations used were generally within the limits outlined above, but with some exceptions, including cases with two tornadoes within the area plus other severe local storms (large hail, damaging windstorms, etc.). Tornado situations were selected for study from occurrences during the tornado seasons of 1945 through 1953. The selection of times and dates for the data was made such that the upper-air data used were either from the 0300GMT or 1500GMT observations, whichever time immediately preceded the time of the first reported tornado in this area. These composites thus present a mean picture 0 to 12 hours before the outbreak of tornadoes.

<u>Summary</u>

GENERAL

1. A veering of wind with height occurs over the area.

2. The geostrophic wind, as measured by the contour spacing, increases with height.

3. The Showalter stability index has a mean value of zero.

SURFACE CHARTS

1. The mean dew point for this area is 60°F.

2. A moisture ridge is observed in all cases over Oklahoma and the axis is near the occurrences of severe storms.

3. Gradient winds are from a southerly direction in all cases with the average speed near 27 knots; the gradient is strong to the east of the occurrences and normally drops off rapidly to the west.

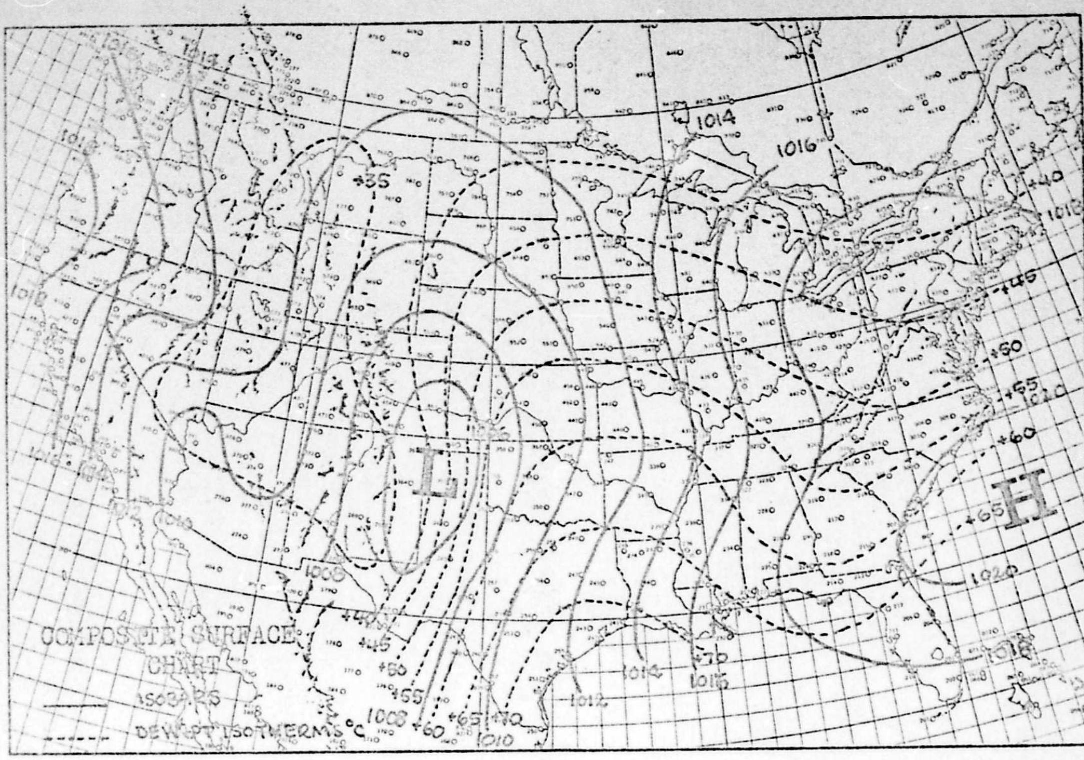
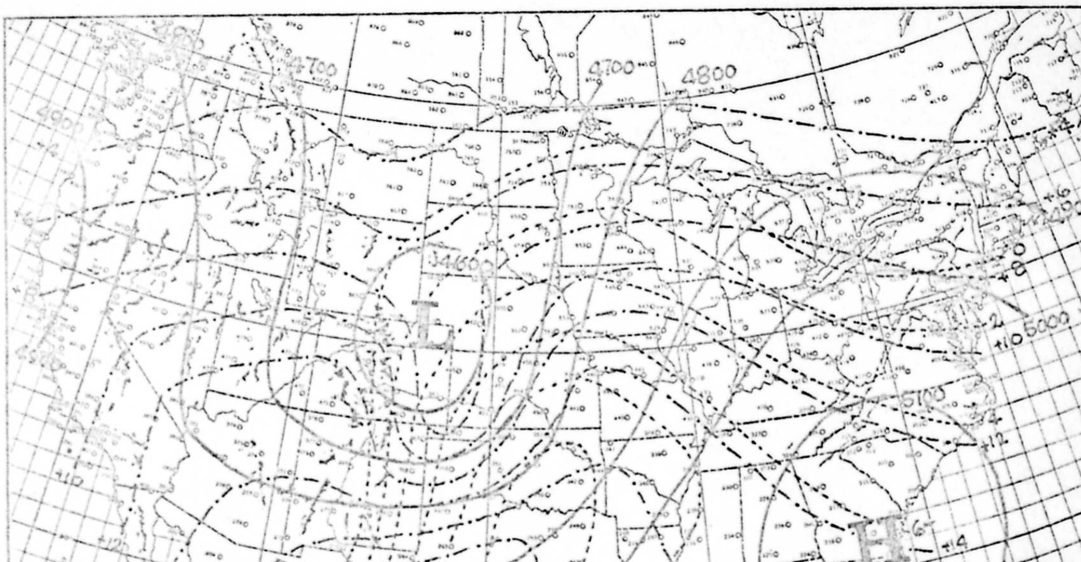


Figure 4-28. Composite maps from 66 tornado situations (449 tornadoes) that occurred in the Oklahoma area from March through June 1945 through 1953.



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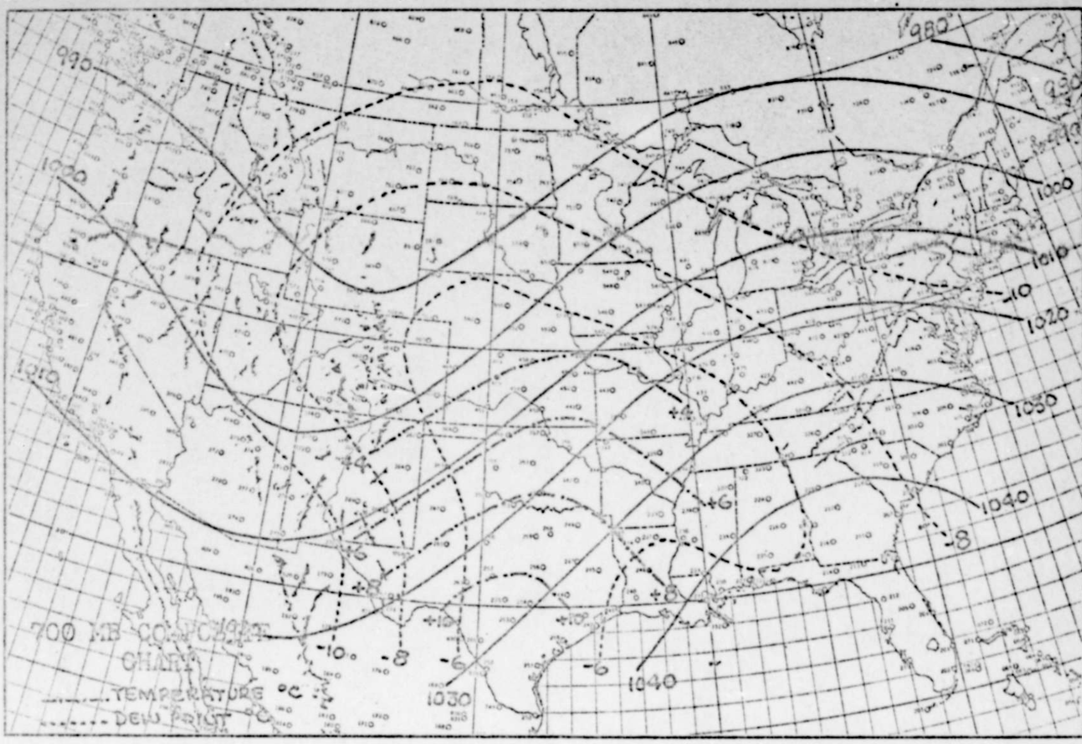
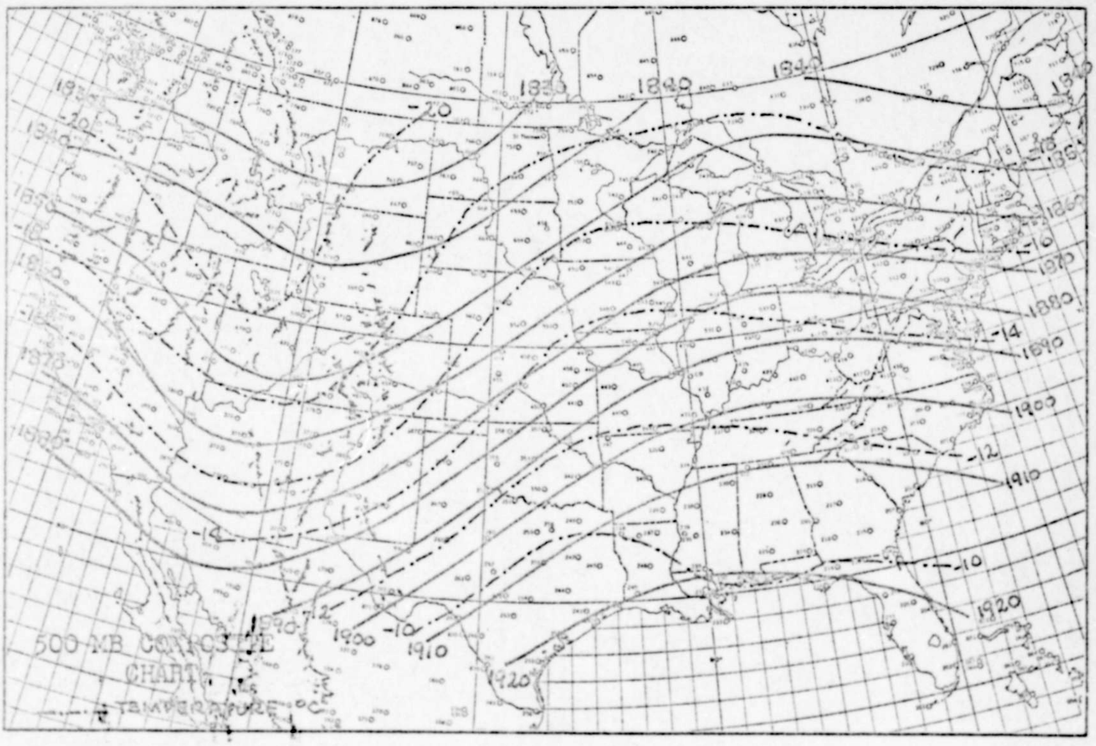


Figure 4-29. Composite maps from 66 tornado situations (449 tornadoes) that occurred in the Oklahoma area from March through June 1945 through 1953.



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S7-0753

LOCAL FORECAST STUDIES

EMPIRICAL RULES

TINKER AIR FORCE BASE, OKLAHOMA

RULES OF THUMB (for forecasting at Tinker AFB, Oklahoma)

1. The following is a resume of "rules of thumb" passed down from previously assigned forecasters (and a few currently assigned) for forecasting the weather at Tinker AFB. No system of verification has been applied to these rules but they have been observed to be generally valid:

a. Air mass convective thunderstorms will not form in the Tinker area unless all winds from the surface to 10,000 feet are less than 15 knots, 10 to 20 thousand feet are less than 25 knots, and above 20,000 feet less than 50 knots.

b. The gustiness of the surface wind velocity can be obtained by multiplying the pressure differential between Gage and Ardmore (in MBS) by four (4). The result will be wind velocity in knots.

c. Overrunning stratus clouds will not dissipate (Become scattered) until winds at all levels through the stratus layer and below it have westerly components.

d. Maximum surface wind gusts associated with pre-cold frontal squall lines will have northerly components a majority of the time regardless of the upper wind flow expected.

e. The minimum dew point at the surface required for the formation of severe thunderstorms in this area is 55°F.

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